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A TEXT BOOK

OF

The Principles of Osteopathy

BY

G. D. HULETT, B. S., D. O.

Revised at the request of the
House of Delegates, American Osteopathic Association,
and the
Associated Colleges of Osteopathy.

FIFTH EDITION
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Preface to the Fifth Edition

This book has been held in favor by members of the osteopathic profession for twenty years. This new edition, the fifth, has been prepared for publication at the request of the American Osteopathic Association and the Associated Colleges of Osteopathy. The following excerpt from the preface of the first edition indicates the author's viewpoint:

"It must be understood at the outset that the work is designed primarily for the student who is beginning to study the new method of healing. Hence to those who are already practitioners of that method the matter contained in the following pages may not seem particularly new nor satisfying in the way of suggesting ideas of an immediately practical nature. Yet we are not without hope that even to the latter class there are many points of interest which will help to throw light upon some of the vexing problems that continually arise in the experience of the busy practitioner.

"Neither should it be assumed that the work is intended to treat exhaustively the numerous questions of theory that are associated with the science. That is entirely beyond the scope of a work that is prepared especially for him who, under the circumstances of a comprehensive curriculum of study, crowded into a period of time all too short, must of necessity limit his reading in all subjects to those texts which give a comparatively brief treatment. This work, therefore, is rather a mere outline of the various subjects that are most closely related to the fundamentals of the science, with suggestions as to the direction further investigation should take.

"The various subjects outlined and the manner of their treatment are the result of the labor of the author, who has been especially devoted to the principles of osteopathy during his course as teacher for the past three years. In large part the work here presented is a revision of lectures delivered before classes in Principles of Osteopathy.

"The work is divided into volumes I and II, indicating a difference in the nature and arrangement of the matter treated. This difference lies in the more general nature of the substance of volume I,

the more specific in volume II. Certain fundamental propositions bearing on the general problems of life, health, and disease are discussed in the former, while the deductions drawn therefrom are applied specifically in the latter to the various regions of the body."

Experience has justified the author's method in using the narrative style. In the book-making the aim has been to combine convenient size, durable and attractive binding, and paper and type comfortable to the eye.

In part, this revision has been based upon some work done by Dr. C. M. T. Hulett in 1915. The more definite work has been done by the co-operation of the Professors of Principles of Osteopathy in the osteopathic colleges. While the amount of work done varies, yet some help has been given by each of the colleges named; they are arranged in alphabetical order:

American School of Osteopathy,
Kirksville, Missouri
A. T. Still College of Osteopathy and Surgery,
Kirksville, Missouri
Chicago College of Osteopathy,
Chicago, Illinois
College of Osteopathic Physicians and Surgeons,
Los Angeles, California
Kansas City College of Osteopathy and Surgery,
Kansas City, Missouri
Massachusetts College of Osteopathy,
Boston, Massachusetts
Philadelphia College of Osteopathy,
Philadelphia, Pennsylvania
Education Department,

THE A. T. STILL RESEARCH INSTITUTE.

Louisa Burns, Dean.

October 20, 1922.

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CHAPTER I

INTRODUCTORY

A statement of the principles which underlie the science of osteopathy must, in the nature of things, be a very incomplete one. No one recognizes the fact more thoroughly than does the practitioner himself when he is compelled to apply theoretical propositions to actual cases. Nor should he be surprised at the discovery. If, as we continually reiterate, osteopathy is a system built upon the facts of anatomy and physiology, then the foundation must be an absolute and knowable one before we may presume to pronounce the building in any sense complete. Unfortunately for the immediate completion of the building, the foundation itself is unfinished, and for an indefinite period of time must remain so. It is a perennially recurring surprise to the student of the biological sciences, to learn that in comparison with what is yet to be determined, the total of demonstrable fact relating to these sciences is relatively so small. When the student, in taking up the study of osteopathy, is told that the osteopath is successful by virtue of his complete knowledge of anatomy and physiology, he glories in the assertion. But when he learns how meager is the equipment of the most expert, he is likely to be disappointed. True, in anatomy we are comparatively well grounded, but our knowledge of physiology and its related sciences is extremely unsatisfactory and must remain so for long. Why need we then apologize for an incomplete statement of the principles of osteopathy? We are not alone in this. The handicap of limited knowledge applies equally to all therapeutic systems. Indeed osteopathy can claim an advantage in the use of what is known, from its sole possession and recognition of the correct principles of interpretation and application of that knowledge. But another fact is very apparent. Dr. Still himself has repeatedly asserted that osteopathy is yet in its infancy. Why pretend then that there be any possibility of presenting it in the garb of maturity? Because of its youth, we must be content with a proper modesty of statement. It is unfortunate that in the rapid growth of the system and in the increase in number of its adherents, sufficient time has not been given to a careful analysis and record of cases which tend to

substantiate the fundamental propositions; and since only an infinite number of observed instances will satisfy the demands of inexorable logic, the necessary data have not yet been collected to warrant unqualified statement. A careful presentation of certain very general but unequivocal propositions, supplemented by numerous provisional ones, is the duty of him who would formulate a "plan and specification," upon which the practitioner is to build his superstructure.

An Art and a Science

It is further necessary to make a fairly clear distinction between principles and practice. It is a peculiar characteristic of the average beginner to long for the opportunity to observe and experiment upon cases. He has imbibed the idea that osteopathy consists essentially in the performance of certain movements upon the patient. But it is necessary to emphasize that before such movement shall be intelligently applied, certain fundamental facts are essential; and it is in the development of these required facts that the principles of osteopathy consists. Dr. Still has repeatedly emphasized that a "plan and specification" is necessary before intelligent work can be done. There must be in the mind of the student a "living picture," not only of the form and feature but also of the function, the tendencies toward and away from the line marked out by heredity, and every phase and fact that may be known regarding the complete life of the individual. It is true no such picture was held by the pioneer in earlier times. It is true that osteopathy, like all other sciences had its beginning as an art. It is no discredit to the science that the art occupies first place in point of time. Musicians and poets were born and the art of music and poetry existed long before the laws of harmony and meter were known. But it is significant that there are few great poets or musicians who are ignorant of the laws underlying their art. The farmer may be able to produce a crop with no knowledge whatever of the chemistry of soils or the laws of plant growth, but the present development of agriculture could never have been reached had not such laws been discovered and formulated. The school teacher may be able to develop the minds of the young and yet be ignorant of pedagogics, but he can never occupy first place. Osteopathy is no exception to this rule. Dr. Still mentions the fact that while yet a boy, a case of headache was aborted by

resting his suboccipital region within a rope swing.[1] That was the art of osteopathy. Similar cases and observation of other facts accumulated until an inkling was obtained of a law underlying the several facts. The recognition of that law and the application of it to still further cases constituted the beginning of the science. The accumulation and systematization of facts, even though many facts remained unexplained, justified the presentation of a working hypothesis. It is the discussion of this hypothesis and the facts substantiating it, the taking it as far as may be from the realm of theory into the realm of demonstration, that constitutes the principles of osteopathy. The application of the principles of specific cases of disease constitutes the practice of osteopathy.

A system of healing cannot properly be separated from a philosophy of life. This is true by virtue of the involved nature of disease. We may prate of pure science and declare that we will accept nothing not susceptible of demonstration, and that a system of healing must depend for its permanency upon pure facts of observation. We may insist that laboratory knowledge is the only brand that will be permitted to enter the sacred field of science. And yet the fact remains that the details of every branch of learning have been wrought out and established through the application of preconceived theories based upon comparatively few facts. The beginning of knowledge comes by induction but its completion is accomplished only by deduction. A theory of life is at the basis of the osteopathic science. The proof that it is a law rather than a theory is the problem of the osteopathic reasoner and practitioner. That proof must of necessity require time, and inasmuch as confirmative evidence is daily accumulated, let no one be discouraged.

[1]Still: Autobiography.

CHAPTER II

AN EVOLUTION AND A REVOLUTION

What is that philosophy? It is both an evolution and a revolution. To make the situation clear it is necessary to look back into history and trace out so far as may be possible the evolutionary outcroppings that have appeared from time to time, culminating finally in a condition that has made possible the revolution inaugurated by Dr. Still. If we turn to antiquity we find an abundance of philosophy with little of fact. Remedial agencies were employed with little regard to the nature or the manifestations of the disease; which is not to be wondered at, because of the paucity of knowledge regarding the body either in a condition of health or of disease.

Ancient Practices

Is is true the records would indicate that in the time of the Ptolemies, post-mortems were held; the ancient Brahmins were aware of the variations in the specific gravity of the urine dependent upon diseased conditions, and practiced a crude form of urinalysis; in some respects the remedial measures of that day may be considered a lost art, for the legends have it that measures were known, the use of which would prevent the pitting of smallpox, and antidotes efficacious for the most venomous of snake poisons were compounded. The Chinese recognized the diagnostic value of changing conditions of the pulse, though the connection between the condition observed and the remedy employed is unexplained. The Hebrews, while recognizing certain fundamental facts in regard to the ethical relations existing between man and man, and the moral relations between man and his Creator, gave to the world little of value in the way of treatment of individual body conditions. The world is, however, indebted to that race for the most elaborate system of hygiene that has been devised, some of the provisions of which might well be incorporated in modern hygienic and sanitary regulations.

Age of Hippocrates

Until the era of Hippocrates little of a permanent nature was given to the world that would assist in solving the problems of dis-

ease and death. In Hippocrates (460—377 B. C.) the medical world recognizes its first great figure, not so great by virtue of any great depth of reasoning, but because of his ability to observe, and further, by his recognition of the necessity for recording his observations. Hence in the Hippocratic collection of writings is found a vast field covered, embracing as it does every branch of the healing art, both of prophylaxis and therapeutics. Hippocrates further deserves the title, "Father of Medicine," because of his work in gathering together not only his own observations, but also those of his contemporaries and his predecessors which he considered worthy. It must be noted, however, that the value of the observations of Hippocrates lies in their relation to the symptoms rather than in the explanations or the treatment of disease. He added to the knowledge of effects but not to the knowledge of cause or its removal. The philosophers, Aristotle and Plato, with their contemporaries, dealt largely with speculation and little with experimental determination. It is interesting to note that in their time arose the pneuma theory, or the theory of the spirits, which in effect was the precursor of Priestly's demonstration a thousand years later, of the presence of oxygen in the air and of the important role that element plays in all life processes. The same era produced Empedocles and Heraclitus, who with their theories of evolution and the struggle for existence, respectively, anticipated Darwin and his followers.

Galen

While the modern biological investigator has reverence for the name and fame of Hippocrates, he recognizes in the Roman anatomist Galen (131—201 A. D.) the first investigator endowed with the so called scientific spirit. That spirit was manifested in experimental methods of study which were careful for that age of the world. As an anatomist and physiologist, Galen was able to disprove some of the contentions of the Hippocratic school as well as to add a considerable number of important facts to existing knowledge by dissections and vivisections. That Galen's influence was profound and permanent is evidenced from the fact that certain of his classifications are still employed, and that for fourteen centuries his word was law. In spite of his contribution to biological knowledge Galen added in a direct way not a whit to the understanding of the cause or the treatment of disease.

The Middle Ages

From the time of Galen throughout the Middle Ages up to the fifteenth century, little advance was made in any of the sciences related to the healing art. Through the schools of France, Italy, and Spain, fact and tradition were preserved unmodified. All knowledge centered in the records of Galen until, with the general revival of learning individuals once more began to investigate and reason for themselves. A striking character arose early in the sixteenth century. Disputant, philosopher, mystic and egoist, Paracelsus (1493—1541) proclaimed to the world a profound contempt for the learning of the past as recorded in books, insisted that knowledge must be gained subjectively, and formulated a theory of nature. Three of his affirmations should be emphasized, first, all nature is a unit; second, nature is never complete, but forever becoming; third, nature is a macrocosm, man a microcosm. That these three ideas have become part and parcel of modern thought, is a proposition requiring little substantiation. The close relation that they bear to the osteopathic doctrine becomes more and more apparent with further study. From this time forward the path of history is marked with the names of individuals who stand out prominently because of added biological facts or demonstrable theorems. Harvey (1578—1657) gave the proofs of a complete circulation and the dictum, in its essentials never yet refuted, omne vivum ex ovo, the former of which had been suggested by Galen and by others less noted. We need hardly dwell upon the importance of both of these facts to the osteopath. Van Helmont (1577—1644) a follower of Paracelsus, emphasized the interrelations between matter and energy, and suggested the doctrine of ferments as explaining the digestive processes. The philosopher, Descartes (1596—1650), while emphasizing certain and numerous ideas of a general nature regarding matter and mind, gave rise to one concept that is of the utmost significance to the osteopath. The idea that man is a machine and that the operation of his organism is dependent upon mechanical laws, is a view fundamental to osteopathic reasoning, and to Descartes we are under obligations for emphatic statement to that effect. Growing out of this conception arose the iatro-mechanical school, whose chief advocates, Borelli (1608—1679) and Marey of our own time, have made the application chiefly to the systems of animal movement; while a rival school, the iatro-chemical,

founded by Sylvius, insisted on the application of chemical principles as explanatory of the various functions.

At this stage in the historical development an immense impetus was given to the investigation of the problems of life by the invention of the compound microscope whereby not only the cellular theory of living structure was formulated, but also the discovery was made of microscopic forms of life. This was followed first by the interminable discussion of spontaneous generation and later gave birth to the germ theory of disease, a theory which has profoundly modified medical thought and practice during the closing years of the nineteenth century. In the latter half of the seventeenth century the English physician, Thomas Sydenham, emphasized another fact which is basic to osteopathic theory. He made emphatic claims for the healing power of nature and thereby anticipated the contentions of all those of later time who insist that it is nature who cures and not the physician. Priestly, in the latter half of the eighteenth century, by his discovery of the element oxygen was able to replace in substantial form the pneuma of the early philosophers, which, entering the body through the breath gave life to its tissues. Haller (1708—1777), following Glisson in the investigation of the property of irritability, enlarged upon the conception of a vital force underlying all life phenomena and independent of known chemical and physical laws—a conception which still commands the adherence of a respectable number of scientists, and which is yet perhaps neither susceptible of proof nor disproof. The relation existing between physiological activity and electricity has been the subject of study since Galvani (1737—1798) proved the generation of electric currents by living tissues, and the recently discovered facts of physical chemistry regarding the electrical nature of certain chemical reactions bid fair to throw further light upon the part played by electric energy in the body organism.

Modern Times

During the nineteenth century a few figures stand out strongly in the further development of biology. In special prominence is noted the tendency of all modern investigators to an objective study, leaving severely alone, too severely perhaps, all matters of a speculative nature. Bichat (1801) remade the science of anatomy

and showed that disease had its seat in the constituent tissues and not in the organs as such. Hahnemann (1775—1843), with his "law of similars" and his insistence on smaller dosages, has most profoundly modified the practice of heroic drugging which had reached an alarming stage. Virchow (1821—1902), with his investigation into the pathology of cells, has cleared up many of the mysteries associated with pathologic conditions, incidentally throwing light upon the general cell doctrine, although his views and those of his followers can but be regarded as extreme and in some respects impossible. Ling (1776—1839), by virtue of his systematization of the various methods of movement cure, gave an impetus to the study of the physiological effects of mechanical stimuli, a fact which has led to no little confusion on the part of both the laity and profession, in regard to the distinction between these various methods and that of osteopathic practice. Hilton, the English surgeon, has emphasized Sydenham's contention relating to the healing power of nature, in its surgical aspects, and has served to show—innocently enough—the essential identity in the standpoint of osteopathy and conservative surgery. Pasteur and Koch and Klebs and a host of others, through their investigations into the processes of fermentation in and out of the body, together with the demonstration of the close relationship between disease and micro-organisms, have greatly added to our knowledge of the pathological changes taking place in many diseases. Modern biologists have added a vast amount of data to the sum of knowledge accumulated in the past, and to them the members of all schools of healing are greatly indebted. In so far as that knowledge has been applied in explaining the cause of disease and suggesting its treatment there is a pitiable poverty. The ground work for a rational system was laid. The inauguration of that system remained for a leader. The use of drugs, which had come to occupy first place among the healing agencies, was found sadly wanting. As early as the first half of the last century, the tendency of the later time was stated by Krukenberg, a German physician, in these words as quoted by Park: "Physicians should be filled with a pious reverence toward nature; the organism is a whole and must be contemplated in this sense; medical art is undoubtedly capable of decisive action, but let us not mistake that in many cases its activity is quite superfluous, in very many null and inadequate, and in many

injurious.'' That there has been a remarkable turning away from drugs in the last half century is evidenced from numerous facts. Note the rise of Christian science and the numerous other cults whose systems are based on the relation between mind and body, which number their adherents by the millions and whose reputed cures emphasize Krukenberg's statement that in many cases medical art is superfluous, and substantiates Sydenham's declaration that the healing power resides in nature; electrotherapy for a time flourished and still has its enthusiastic admirers; hydrotherapy has become an adjunct of practically all systems, the use of which has been emphasized out of proportion to the possibility of its abuse; the development of serotheraphy co-existent with the development of a knowledge of toxins produced by pathogenic bacteria has had far reaching results; the known facts relating to internal secretions, together with the observation of pathologic conditions resulting from the absence of some organ, usually a ductless gland, has led to the rise of organotherapy, and has served to distinguish between organic food elements and inorganic chemical substances. The rise of these various systems, all indicating the desertion of the drug has not been dependent upon a realization by the physician alone of the inadequacy of the drug, but equally upon that realization by the thinking laity. The time was ripe for a revolution in the conception of cause and treatment of disease.

CHAPTER III

THE REVOLUTION

It was stated that in osteopathy not only was there an evolution but there was a revolution. Heretofore the physician had confined his attention to the appearances in disease, which in truth was all that he could do inasmuch as the cause remained unknown. Every system of treatment thus far developed had been one designed primarily to combat effects. It remained for Dr. Still to determine the fundamental cause of all disease and to inaugurate a system of treatment based upon that cause. What constitutes the distinctive feature of this revolution in the concept of cause and the method of treatment of disease? All systems and sciences, whether related to healing or other aspect of human endeavor, are a result of growth. Growth presupposes a beginning less mature than the end. Hence it were presumption at the present time to attempt to set definite limits to the science of osteopathy. Professor Ladd of Yale states a very important fact when he says that the proper definition of a science is one of the latest and most difficult achievements of that science. Recognizing the extreme youth of osteopathy we must be content with only a provisional setting of limitations in any attempt at a statement of its constituent elements. Admitting this to be the case, yet it is not deemed presumptuous to attempt to formulate in a concise manner the essential ideas in the form of what may be called a definition. We certainly cannot assent to the proposition that no statement of principles shall be given definite form because we may have reason at a later time to retreat. A policy of negation is as destructive to all progress in science as it is in politics. If the system of osteopathy is to be advanced, if it is to be established upon demonstrable law, if it is to be relegated to the oblivion of error it will be developed in the best possible manner by giving it definite direction and force through the formulation of a specific program based upon a definite working hypothesis. From time to time as further discovery of truth shall suggest, that program or hypothesis may be modified. It is significant that thus far in the history of its development no fact has been demonstrated that has modified in any essential way or

degree the primal osteopathic concept. If care be taken to analyze the apparently contradictory conditions which have been reported we believe that it will be found that instead of modifying the original concept, they but confirm and make it the more impregnable.

It is needless to say that a single word cannot indicate in any comprehensive way the nature of the system. Hence no attempt is made to explain in any apologetic or compromising terms why the word osteopathy came to us. It is insisted, however, that as compared to the terminology of other systems the word osteopathy is much more representative of the system and is far superior to any other name that has been suggested. The legal definition given to the system by statutes refers to it as a "system, method, or science of healing." That it is systematic and methodical is recognized at a glance. The more pertinent inquiry remains, is it a science? That it is not a completed science has already by inference been emphasized. That it embraces all the elements of a science is affirmed. The definitions that have been given for the word science have been many and various. Succinctly, systematized truth may serve the purpose as well as many of a more pretentious character. In so far as the facts that have been gathered when arranged in definite logical order tend to support a definite hypothesis, we have a science. In so far as the conditions in disease are shown to depend in definite ways upon certain properties of the structural arrangements, thereby occupying the relation of cause and effect, we have the essentials of a science. Finally, inasmuch as anatomy and physiology are sciences, osteopathy, which is but the application of these two toward the cure of disease, must partake also of the nature of a science. True, there are many things in the osteopathic system yet to be recognized and classified, but that fact does not in any way impair its validity as a science.

Not touching upon the details that yet remain to be worked out, a technical definition must suggest a theory of the cause, and the treatment, of disease. In regard to the latter it must embrace not only therapeutics but prophylaxis as well. For medicine in the broad use of that term must include, in addition to measures employed to assist the body in recovering its equilibrium, also those designed to assist the organism in maintaining that equilibrium. Indeed the latter is logically of far greater importance, but because

of an unfortunate tendency on the part of human nature to procrastination the former will of necessity demand the most of the physician's labor. In order that the definition shall include essentials and provide a basis of support the following propositions must be either directly or by inference included:

1. Cure is the prerogative of the organism.

2. Functional disorders will be self-adjusted except where complicated with or dependent on structural disorders which are beyond the limits of self-adjustment.

3. Removal of structural disorders constitutes the treatment.

In accordance with these provisions the author has elsewhere suggested the following definition of the distinctive features of osteopathy: A system of therapeutics which, recognizing that the maintenance and restoration of normal function are alike dependent on a force inherent in protoplasm, and that function perverted beyond the limits of self-adjustment, is dependent on a condition of structure perverted beyond those limits, attempts the reestablishment of normal function by manipulative measures designed to render to the organism such aid as will enable it to overcome or adapt itself to the disturbed structure.[1] The elaboration of the various provisions in this definition will appear as the subject is further developed in the following chapters.

The definition offered by Dr. C. B. Atzen and approved by the American Osteopathic Association, June 29, 1919, is as follows: "Osteopathy is that system of the healing art which places the chief emphasis upon the structural integrity of the body mechanism as being the most important single factor in maintaining the well-being of the organism in health or disease."

[1]Journal of The American Osteopathic Association, May, 1902.

CHAPTER IV

SOME FUNDAMENTAL CONSIDERATIONS

Viewpoint of Life

In another connection it was stated that a system of healing cannot be separated from a philosophy of life. As introductory to a further study of the osteopathic doctrine it is necessary to consider in brief a few aspects of the life problem. Not that it is possible to give an accurate definition of life; for it is obvious that no such definition can be given of a thing, the essential nature of which is unknown. For we know not what life is; we are only acquainted in part with the substance with which life is associated and with a few of its manifestations. We know that in one sense life is a property of a certain kind of molecule but the explanation of the property and how it is associated with the molecule is not forthcoming. We know that life is inherent in this certain kind of molecule. Dr. Still has stated that life is an individualized principle of nature. A part of the universal life has become individualized in an aggregation of protoplasmic molecules. How it became thus individualized, and at death again becomes merged into the universal life, is yet, and in all likelihood will always remain, a mystery. The materialist hopes sometime to be able to explain life in terms of physics and chemistry. While it is true that a large number of functions formerly considered vital, in the sense of being out of the realm of physics and chemistry, have in more recent years been in their gross appearances satisfactorily explained on purely physical or chemical laws, yet a vast number of much more difficult functions as well as the finer details of every function remain entirely beyond physical or chemical explanation.

While it is thus not possible to accept the materialist's conception of living matter yet recognition must be made of the fundamental importance of chemical and physical law as a basis for functioning. The chemical nature of protoplasm is significant; composed of a dozen or more of the known elements most of which are of low atomic weight, we find a very complex molecule. If paramount importance can be assigned to any single element, nitro-

gen could reasonably be placed first. That element is characteristic of living material and is fundamental in giving to the complex molecule some of its own peculiarities. Nitrogen unites with a sufficiently large number of other elements but in comparatively loose combinations, separating readily to form new associations. It is in this respect that nitrogen is of prime importance to the living molecule. The most striking characteristic of living tissue is its tendency to continuous change not only of a physical but also of a chemical nature. The response to a stimulus is dependent upon this readiness and since life may be considered in large part a response to stimuli the necessity for the ability to change becomes apparent. In this connection Herbert Spencer's classical definition of life is illuminating: The continuous adjustment of internal relations to external relations. As there will be occasion to refer repeatedly to the fact of adjustment this conception of life should be borne in mind. Every change in the environment of the organism constitutes a stimulus of greater or less intensity upon that organism. The continuous proper response to these stimuli represents a normal condition of the organism; a failure to respond, or a response too intense or insufficient is evidence of and further cause for a disease condition. In the sense of a continuous response to continuous stimuli the organism constitutes what Spencer calls a moving equilibrium. When that equilibrium becomes disturbed by too intense or too prolonged stimuli disease results, while in the continuous adjustment to circumstances is seen the normal condition of the living organism.

Considering life, then, in certain of its manifestations, it is observed that the law of change is a law of living matter as represented in man. The study of those changes and the determination of methods to assist the organism in its response to normal stimuli and in its resistance to abnormal stimuli, constitutes the life problem of the physician.

CHAPTER V

STRUCTURE AND FUNCTION

In this continuous adjustment dependent on change in the physical and chemical relations of the molecule above referred to it is to be noted that both structure and function are concerned. Discussions are rife regarding the relative position of structure and function in the development of an individual or of a race. It is not advisable to enter into the argument except to indicate that for all practical purposes the two develop co-ordinately. That structure changes function in countless cases must be admitted. This fact is fundamental in osteopathic theory, according to which most diseases are either caused or maintained by structural conditions interfering with function. On the other hand it is equally certain that in numerous cases there is evidence of the modifying influence of function on structure.

The doctrine that makes the cell the fundamental biological unit, and the physiology of the body but the physiology of the cell, is insufficient to explain all the phenomena of the complex, organized, living being. The cell represents one expression of life which is inherent in the common structural basis, protoplasm. There is an organizing force that lies back of all structure whether the latter be composed of cells, intercellular substance, or of syncytia. That force is unknown but it represents an action, an energy, a function. In this sense reasoning is justified in insisting that function is a cause of structure. This assertion, however, may be followed by the equally obvious statement that before that organizing force can express itself in any substantial way it must have a structural basis. That structural basis is protoplasm. From this standpoint structure governs function. Throughout the growing period of the individual, function is continually changing structure. Marey calls attention to the development of grooves and depressions in the growing bone from the continuous functional activity of the growing muscle and other soft tissues. As the individual uses to excess one group of muscles, the prominences to which the muscles are attached are correspondingly increased. The muscle itself, as in the

case of the heart in certain valvular disorders, becomes remarkably hypertrophied. A disorder of the stomach, through the increase of nerve impulses that pass from it, initiates changes which result in perversions of form, more noticeable in the case of muscle tissue. All of these are instances of the power of function to modify structure. In large part it will be noted that the functioning energy only modifies the structure in the process of growth, compensation, or any condition where a definite purposeful action seems necessary. As soon as the functional activity or the energizing force has brought forth and builded its own instrument of manifestation, observation of the human body, that of the lower animal, and to some extent, plant life, all show that function then becomes subject to the mechanical conditions of the structure and form. Thence on, more noticeably than during the previous period of growth or compensation, structure becomes modified only inappreciably and gradually by function. The more inert structure once formed—made ready for the indwelling of the animating force—if disturbed through various forces acting upon it, is in considerable part unable to adjust itself immediately, with the result that the function must suffer and continue so to do until the structural condition be overcome with or without the aid of some extraneous factor. Therein lies the essence of the whole argument. Admitting that function can modify the structure, it can much more readily modify itself and hence is practically self-adjusting. On the other hand, structure is only passively self-adjustive and hence will likely remain in its abnormal condition until some external force it brought to bear. Here lies the work for the physician. Structure is disturbed. Function must of necessity suffer as a result, and symptoms of disease follow. The physician can attempt to change either function or structure. Which shall it be? Function being self-adjusting, and dependent on structure needs no artificial aid. Structure, being more helpless so far as self-adjustment is concerned, and being directly responsible for maintenance of the perverted function, demands the attention of the physician. His work in assisting in structural adjustment is the only external or artificial factor that is justified.

The Cell Doctrine

From the middle of the seventeenth century, when Schleiden and Schwann discovered in the case of plants and animals respec-

tively that living material is composed of innumerable microscopic parts having a more or less definite shape, up to the present decade, the cell doctrine has been growing in importance as one of the great facts of biology. When the nature of the cell was first determined and the so called essential elements had been differentiated from the non-essential, it was believed that a long step had been taken toward the solution of many of the life problems. As the investigator learned that each of these individual divisions had a more or less distinct life of its own, the attention of the physiologist was turned from a consideration of the action of cell groups to that of the individual cell, until in the literature of to-day the statement is constantly reiterated that the problem of physiology is the problem of the cell. Virchow, in his monumental work on the cell structure with special reference to its pathology, has emphasized more than any one man the individuality of the cell and the fundamental necessity for normal cell life in order that body activity as a whole shall be normal. His coworkers and followers have assisted very materially in definitely showing the great part played by the cell in the activity of every living thing. Yet while all this is true it must be insisted that the problem of physiology can never be solved by the rule of the cell, and that for the reason that the cell is not the fundamental element nor the essential fact in living tissue. Within later years the extreme views have been modified and modern investigators are searching for the demonstration of what may provisionally be called the ante-cellular elements. That such exist there can be little question. That is, more simple elements which have the fundamental life faculties, lie back of the cell and are responsible for the cell. If it were asked what is the simplest possible conception of life in its manifestation, it could logically be insisted that protoplasm plus an organizing force dwelling within that protoplasm constitutes the simplest conceiveable life condition. This conception is not that of the cell doctrine as commonly understood. The structural conditions necessary in the cellular arrangement are but one of the expressions of the life and hence are but incidental. "All parts of the cell are but the local differentiation of a common structural basis."[1] The cytoplasm is one specialization, the nucleoplasm is another, and the cell wall is a third of the specializations of this structural basis. It is not

[1]Wilson: The Cell in Development and Inheritance.

enough to say that there must be the combination of nucleus and cytoplasm in order that life may be manifested. It is a common statement that the nucleus is necessary and hence any protoplasm devoid of a nucleus cannot represent the fundamental unit. But cytoplasm does live and does manifest life after having been separated from all connection with nucleoplasm. It shows amoeboid movement, it is irritable, it flows about nutrient substances and digests them. Hence life is still present and without question there are present more elementary biological units. To the objection that the cytoplasm very soon dies, and under no circumstances can reproduce itself, it may be replied that the same is true of any of the complete cells of multicellular man when they have become separate. Many cells live in which no nucleus is demonstrable. And yet these organisms are eminently alive. They move and select or reject food substances and reproduce their kind. The difference between these and the cellular organisms, so far as life itself is concerned, is one only of degree and complexity, not of kind.

CHAPTER VI

UNITY OF THE BODY

With modern methods of research our knowledge of the actual structural conditions of the human body has been considerably increased and in large part corrected. One of the more striking of the observations which bear directly upon the subject in hand, has reference to the fact that the body is by no means entirely made up of cellular structure. It has long been known that in the case of plants many of their cells were structurally continuous. The same fact has been shown to be true in the case of animals. In the developing ova of fishes it has been found that the cells as they were formed were not separated but still maintained the continuity of their protoplasm. The same is true with reference to the ovarian cells of certain mammals. In the higher animals, including man, many epithelial cells on close inspection show the presence of protoplasmic bridges. Cartilaginous and many other forms of connective tissue cells are connected through protoplasmic extensions. In the case of the muscle cells of the heart is seen a typical condition. There the cells are markedly branching and the branches are continuous one with another. This is of fundamental interest, as throwing light upon the peculiar properties of the cardiac muscle. All investigators have noted that the contraction of the heart takes the form of a wave passing downward from the sinus venosus to the apex. It was formerly assumed that this wave was propagated from auricle to ventricle through the medium of nerve connection. This is now believed to be erroneous, since the nerve tissue can be rendered ineffective while the propagation of the wave remains unaltered. What is the explanation? Older anatomists taught that there was no muscular connection between auricle and ventricle. This, according to Gaskell, has been disproved and it is now known that the propagation of the contraction wave from auricle to ventricle may take place through the continuity of muscle protoplasm or via the atrio-ventricular or muscle bundle of His. While the continuous nature of cardiac muscle cells has thus been recognized it is only within more recent years that proof was given for a similar though less marked condition in the case of most

involuntary muscle tissue. This becomes of special interest because of the fact that a contraction wave started at one end of the intestinal canal passes through a greater or less extent of the tract without further stimulus. Therein further lies the suggestion of an explanation of the Traube-Hering curves which are produced by the rhythmic action of the arterial walls and which are entirely independent of the pulse.

From the above considerations it would seem that the conception of the human body as a syncytium is not inappropriate, and that there is justification for the conclusion stated by Meyer that both the plant and the animal individual are continuous masses of protoplasm in which the cytoplasmic substance forms a morphological unit whether in the form of a single cell, a multinucleated cell, or a system of cells.[1]

What is the significance of the cellular arrangement? Admitting that such is present in the organism in an all but universal degree, what purpose is subserved thereby? Several suggest themselves. Note that the total bulk of protoplasm in a body weighing one hundred and fifty pounds must be considerable. Supposing this bulk were homogeneous and undivided, what would be its structural peculiarity and its form? Protoplasm is fluid, hence the lack of mechanical support would be a serious hindrance to all of its functions and a complete prohibition of many. By virtue of the structurally differentiated cell wall, the intercellular substances, and the various deposits of lime and other salts, such support becomes possible. A provision for growth is a second advantage in the cellular arrangement. Note that every living substance can be nourished only by the process of absorption of foods through the surface which is presented to the surrounding medium. Note further that as bodies grow the ratio of their increase in bulk to their increase in surface is as the cube to the square. Hence in order that any marked increase in size may be possible, special means must be provided for an increase in surface, in the absorptive area through which food materials may pass into the protoplasmic substance. By means of the division and subdivision into more or less distinct cells, this increase in area is provided for. A third advantage is seen in the possibility of specialization in function. This is in part dependent upon the changes of shape that take place

[1]Wilson: The Cell in Development and Inheritance.

in the cell, but more upon the change in the intimate nature of the protoplasm itself—a change that largely defies investigation. It is at once apparent that a completely continuous and homogenous mass of protoplasm would be an insurmountable barrier to marked specialization of function. The difficulty is materially reduced by the mechanical divisions produced in cellular development.

Since the cell is not distinct and independent, and the body may rightly be considered a syncytium, what are the legitimate deductions? Reference has previously been made to the necessity of considering the body as a whole and not as an aggregation of independent particles. This is fundamental in the osteopathic philosophy and practice. If the body is a unit then the practice of removal of any organ of the body because of its supposed absence of function is fundamentally erroneous. All organs and all parts of the body perform to a certain extent all vital functions. While there is specialization no part of the body completely loses its original properties. This emphasizes the fact that the human organism manifests the most complete as well as the most simple functioning capacities, and doing so, it can meet all conditions of human environment on a common level, whether those conditions themselves be complex or simple. And this is of importance in the organism's struggle for existence. When man is compelled to resist another organism of complex nature such as other mammals, he may do so by the use of his own specialized complex nature. He can meet brain with brain and muscle with muscle. Compelled to resist the effects of poisonous substances, whatever the occasion for their presence in his body he may meet toxin with anti-toxin. Compelled to withstand invasion of his own body by the unicellular organism, such as a pathogenic bacterium, he may meet cell with cell, for phagocytosis is an accepted physiological fact. The same idea is emphasized in the case of the internal secretions. It is known that many of the organs of the body provide certain substances that are essential to the body as a whole. It is doubtless true that every part of the body gives and receives from every other part, and Spencer's suggestion is significant that a particle of protoplasm may during the course of time pass to all parts of the body.[1]

A furthur interesting suggestion along this line refers to the relation between this bodily unity and various reflex disorders and

[1]Herbert Spencer: Principles of Biology, Vol. 1., p. 192.

chains of disorders. A pathologic condition of a group of cells may affect the nerve connections or the quality of the blood or, through the added influence of the flow of protoplasmic substance or force, may change the metabolism of remote structures. Virchow himself has suggested that the reticular arrangement of cell continuity, will much facilitate the conduction of various morbid processes.[1] This fact would emphasize the necessity of looking to other parts of the body for irritating factors rather than merely to the regions commonly involved through a disturbance of the nerve or blood mechanism.

In like manner may be understood the deleterious effects on other and all parts of the body from the administration of drugs. It will thus be impossible to limit the action of a drug to the tissue involved in the disease; once having come in contact with the protoplasm of a single cell, unless thrown out by defensive action, the chemical irritant may pass to every other part of the body.

Emphasis has thus been laid upon the fact of protoplasmic continuity, mainly to draw attention to the necessity for considering the body as much more than the sum of its parts. While with Virchow we may assert that "every animal presents itself as a sum of vital unities, every one of which manifests all the characteristics of life,"[2] this can be but a half truth. The cell in the multicellular organism is certainly dependent on associated cells for its proper performance of function. The extent of that dependence is as yet undetermined. Recent investigations relative to the facts of internal secretions suggest the supreme nature of this dependence, and while the presumption is that the secretion is given to the blood and lymph to be carried to those dependent cells, yet for aught we know these substances and much more subtle influences may pervade the body through the medium of this closer connection of protoplasmic continuity; and we believe that there is much of practical value to be gained by considering, with Krukenberg, that "the organism is a whole and must be contemplated as such."

[1]Virchow: Cellular Pathology, p. 76.
[2]Virchow: loc. cit.

CHAPTER VII

CAUSE OF DISEASE NOT IN THE CELL

From the extreme views of the cellular structure which have followed the investigations of Virchow and others, there has arisen a conception of disease which to say the least is decidedly inadequate. From the view that the body is but an aggregation of groups of cells related only through a common nerve and blood supply, and each of which has its own independent function, comes the natural inference that disease constitutes an independent and inherent faulty condition in the activity of those cells. By the demonstration that protoplasmic metabolism was able to synthesize various substances that were auto-toxic, a key to numerous diseases was believed to have been found. So far as a superficial conception goes the assumption is correct. It is true that every cell and every particle of protoplasm may produce substances which are actively toxic to the living protoplasm if those substances be held continuously in contact with the protoplasm. It is not unlikely that any product of normal katabolism is equally disastrous if permitted to remain. Every one has experienced the sensation of fatigue. What is the peculiar sensory condition present? Undoubtedly it represents an excess of normal waste material acting upon sensory nerve endings. Every student of physiology is aware that in fatigue a definite toxic substance is produced. The blood serum taken from a fatigued animal and injected into the vascular system of one in a rested condition, will produce in the latter every symptom characteristic of a fatigued animal. Influenza produces similar symptoms and Verworn has attempted to identify the two conditions or at least to show their marked similarity. In this condition there is present a material toxic to the cell and irritant to the nerve terminal in a manner similar to the effect of the sarcolactic or other acid always present in excess in overworked muscle tissue. The presence of the bacillus causing influenza is not necessarily a detriment to the organism but in many cases pathological conditions may be caused in part from its activity. In these it is not the presence of the bacterium merely but of its excretion products that constitutes the deleterious influence. Whether it be a toxalbumin similar in kind

to that produced by body activity remains to be demonstrated. Sufficient for present purposes to note the fact that the material is toxic and must of necessity produce cell disorder if present in sufficient amount and for a sufficient period of time. Whatever the source of the toxic material, whether it comes from bacteria, over exercise, or perverted cell metabolism, it is immediately a possible cause for harm.

Metabolism

These considerations in reference to faulty metabolism have led many into error. The statement is made that the cause of disease resides in the metabolism of the cell. This is true only in a limited sense. A more nearly correct statement would be that the disease is the faulty metabolism of the cell. It remains to trace the faulty metabolism to its source. It is obvious that, theoretically, numerous forms of stimuli may come into relation with the cell protoplasm to modify its activity. Mechanical, thermal, chemical, electric, nervous stimuli—all are known to affect protoplasm. But in every case these influences must be brought over channels that connect cell with periphery or with center. For the cells constituting the organs usually involved in disorder are deeply situated in an environment of comparative quiet. Mechanical pressure does not act as a serious stimulus because that pressure is constant. Thermal conditions are unfavorable for producing response since it is only a sudden change that is an efficient stimulus. Chemical stimuli only reach it through the medium of channels which transmit fluid capable of performing the office of a vehicle, while nervous influences are similarly carried over definite pathways. Nerve impulses govern blood vessels and thus indirectly the quality of the blood. Nerves are dependent upon blood for their nutrition. The cell is thus dependent, not only upon both blood and nerve supply, but also upon a proper relation between both of these, for its proper functioning. Over all is exercised a co-ordinating power, seemingly inherent in protoplasm and by which the cell is maintained in balance between its anabolic and katabolic processes. Hence so long as the channels connecting cell with periphery and with center be kept free, no break in the chain of events constituting the metabolic cycle is possible. The normal hydrostatic and osmotic pressures are maintained at such a level as to necessitate

correct functioning in vital selection. Nutrient materials are taken in from the blood with ease and rapidity. Waste materials are discharged with equal facility. Fatigue cannot long persist since a growing loss of irritability necessitates rest. Bacterial products though present in the blood do not remain long, since normal protoplasm secretes antitoxin and the neutralized substances excreted. An uninterrupted nerve influence keeps up constantly normal chemical and vital protoplasmic changes. Under such circumstances the cell, vital and self-sufficient, cannot easily go wrong in its action.

Circulation

But modify the conditions associated with the channels of interchange and note the result. Changes in blood supply and drainage permit changes in osmotic conditions and hence changes in activity of the cell selection and rejection; lessened cell nutrition and cell regulation result. Metabolism may be abnormal from changed nature of nerve influence. Undoubtedly in the case of most cells of the body, their activity is partly under the control and coordination of nerve influence. An excess of that influence may cause the accumulation of the katabolic products constituting the occasion for fatigue. This means that the nerve initiates a too rapid transformation of potential energy of cell protoplasm into kinetic energy of chemical and vital activity. This additional activity further initiates new changes immediate and remote and a chain of events is inaugurated. A deficiency of nerve influence, on the other hand, permits a lowered resistance to other stimuli, with one or both of two effects, a trophic change in the tissue or a perverted quality of metabolism. In the latter case the complete products of the normal "metabolic cycle" are not formed and hence various types of degeneration may follow.

Structural Causes

How are these interferences produced? Largely by changes in structural relations of those tissues least subject to vital control, such as connective tissue, especially bone and ligament. In this connection note that it is not correct to state that the lesion causing the disorder is a lesion of the cell. The unreduced structural perversion called the osteopathic lesion is essentially tissue without

power of self-adjustment; it is not protoplasmic but consists chiefly of passive intercellular substance. Why is bone so slow to yield? Not because of living cells in bony tissue, for they are probably as self-adjusting as similar protoplasmic aggregations in other tissues; but because incorporated within the osseous tissue there is a predominant amount of lime deposits which give to the bone its unyielding character, and which have no powers of self-adjustment.

In ligamentous and other connective and supporting tissues it is the more inert intercellular substance that constitutes the difficulty in self-regulation when a lesion occurs; hence the emphasis placed upon bony and ligamentous lesions in relation especially to chronic disorders.

In the absence of the abnormal structural conditions suggested, any failure to supply the blood with materials from which the cell claims its pabulum, any abuses or excesses, must have deleterious effects upon the cells themselves. But such effects are temporary unless there has been permanent structural injury, for as soon as any cause of injury has been removed, repair is rapid and usually complete.

Altogether it would seem that the cell normally present in the body cannot of itself cause disease either in itself or in its neighbors. It is inherently healthy and is incapable of harm until the connection between it and its blood stream, lymph channels, nerve centers or other normal relations have been impaired. Interference with these by persistent pressure from displaced structures or by accumulation of fluid, not subject to vital control, constitutes the factor which produces or maintains disturbances in cell metabolism.

CHAPTER VIII

MAN A MACHINE

The Body a Physical Mechanism

It was stated that underlying the practice of osteopathy there is the recognition of a close and fundamental relation between structure and function. Reference was made to the fact that the human body in structural aspects partakes of the nature of a definite machine, the operation of which follows definite mechanical laws. Its cellular arrangement is incidental, but is advantageous in its relation to the physical support of so large a mass of protoplasm, its proper and perfect nutrition, and its differentiation of function.

That man is a machine is an assertion trite enough, yet one that demands some consideration. A machine is an instrument by which force is changed in direction or intensity, the change being associated with the transformation of energy. While the mechanic employs a vast number of mechanisms, yet with the exception of certain electrical appliances, all may be reduced to a few simple machines, viz., the lever, the pulley, the wedge. Each of these is represented in the human body. Practically every action of the voluntary muscles is dependent upon the principal of the lever. When one extends his forearm he does so by the use of a lever of the first class; when he forces his body from a wall by placing his hands against it the lever is of the second class; when he flexes his forearm he employes a lever of the third class. Borelli and Marey in their investigations relating to the action of the locomotor organs have shown by mathematical and other demonstration the nicety of adjustment of those organs to the work required to be done, emphasizing thereby the purposefulness of the peculiarities in body structure. In the superior oblique muscle of the eyeball, in the peroneus muscle, and in the long head of the biceps, are represented the pulley action by which the direction though not the intensity of the force is changed. In the "bag of waters" at parturition, in peristaltic action, and in certain factors of the process of vomiting are seen illustrations of the principle of the wedge. The laws of hydrostatics and hydrodynamics are made use of in numerous cases.

Pascal's law of fluid pressure is at the basis of blood distribution and blood flow; capillary attraction, osmosis, filtration and diffusion, play no inconsiderable part in body functioning; the fenestra rotundum of the middle ear with its membranous covering is a provision for the law of fluid incompressibility. The laws of air pressure are utilized in the processes of respiration and circulation, and in giving support to the articulations and the viscera.

While it is thus recognized that man is a machine, the term mechanism is one more descriptive of the real condition, in that the former carries with it by association the idea of rigidity and unyielding parts. This latter is obviously not a peculiarity of a living organism in which continuous change is characteristic. Further, mechanism involves the idea of complexity which is noticeably characteristic of the human body. But whether machine or mechanism, it is to be remembered that the principles operative in each are in large part similar if not identical.

A Chemical Laboratory

The body is not merely a machine by reason of which it can produce various changes in the nature of the energy with which it comes into relation; and through the operation of purely physical laws that are possible of expression through the arrangements of its numerous parts it can perform the function of a physical laboratory. It is in addition a chemical laboratory the capacities of which have a reach that is entirely beyond the artifice of man. Substances are formed, torn down and re-formed, which have no counterpart in the world outside of organic life.[1] No man has yet been able to synthesize living proteid from the inorganic or organic materials at his command. Even in those syntheses which have been made artificially they were first secured by the means of forces never possibly present in living tissues, such as high temperatures, concentrated and destructive acids, alkalies and gases, powerful electric currents, and other conditions whose very presence would

[1] "The power of the living cell to effect chemical changes in the substances which it absorbs is most incredible, for alizarin blue, one of the substances which Ehrlich has employed, can only be reduced by the most powerful agents outside the body, for example, by boiling with caustic potash and grape sugar, and yet it is completely reduced within the living body by the liver and by the cortical substances of the kidney, and is rapidly reduced after death by the heart, liver and muscular substance."—Brunton: Introduction to Modern Therapeutics, p. 96.

immediately destroy all vital processes. More recently, many of these reactions have been secured by means of inorganic catalysts, by unorganizd enzymes and by certain chemico-physical states not yet well understood, but which may, conceivably, be associated with the vital activities of tissues.

We may take the living tissue and analyze it, but when the analysis begins the proteid has lost its life essence. What remains we may analyze and determine in part its constituents. We may take of the products of living proteid and after analysis draw conclusions as to the original living tissue. But we are yet in the dark as to the fundamental quality in the chemical nature of living protoplasm. Even the complete formula for the dead protoplasm defies exact statement. Even when that is once accomplished we shall have little reason to hope for an immediate determination of the composition of the living tissue. The very act of analysis destroys life, and within the sacred precincts of the living proteid molecule we may not go, and the discovery of the intimate nature of that substance must continue to be a subject for speculation and not demonstration so long as we can anticipate.

That the conditions needful for chemical action are strikingly present in the human organism need hardly be emphasized. Suffice it to suggest a few facts that call attention to it. The body as a whole is over sixty per cent. water. The essential living part of the body, the protoplasm, contains a sufficiently greater amount to render it distinctly fluid. This fact is of fundamental importance from the standpoint of chemical possibilities. That it is fluid rather than solid is suggested by the fact that it flows as in the case of the streaming process noted in the cells of certain plants; by the tendency which the white blood corpuscle and other typical protoplasm exhibits to assume a spherical shape; and the further tendency of other fluids to assume that shape when absorbed within an environment of protoplasm such as is noticed in the case of fat droplets. Owing to this fluid nature chemical action may take place more efficiently and more rapidly, which is a fact of considerable value for the purpose of quick response to stimuli so necessary to a complex life. Contained within this fluid material are found a dozen or more of the lighter chemical elements held in rather loose chemical combination so that when materials from the outside world have become absorbed into the protoplasmic substance a

rapid change of atomic and molecular association is readily affected. In another section reference was made to the fact that of the elements found associated with protoplasm a few are of fundamental importance, namely, the oxygen, the hydrogen, the nitrogen, and the carbon. A few others seem to be essential but perform a less important role in metabolism, while still others in special forms may be present or absent. The proteid material found in the body is in large part what is spoken of as combined proteid. Jaquet gives the following formula of one of the most important of the combined proteids, namely, hæmoglobin, which suggests the extreme complexity of the substance and the infinite possibilities of rearrangement in the processes of vital chemistry: C_{758} H_{1203} N_{195} Fe_1 S_3 O_{218}[1]. This represents but one of a large number of the combined proteids. If we permit ourselves to dwell upon the resources from which the body chemist may draw and the numerous products that are continuously formed we cannot be otherwise than astonished at the unerring precision and nicety of adjustment which is maintained throughout the life of the normal individual.

The division point between chemical action in the body and that dependent on other forms of energy is not a definitely determined one. Yet we know that many of the fundmental facts of physiology are largely chemical ones. Proteid foods in the alimentary canal are acted upon by the pepsin and the trypsin and reduced to simpler and more diffusible forms in a manner seemingly entirely identical with that which takes place outside of the body. The oxygen entering the blood and later the tissues, forms a combination with carbon which is identical with oxidation processes wherever found. Hydrogen and oxygen unite to form water in a manner similar to its synthesis elsewhere so far as can be determined. Urea, formed by the liver cells from ammonia and carbon dioxid in the blood, is in all likelihood the result of a process similar to its formation in the chemist's laboratory. Thus is emphasized the fact that the body organism is capable of chemical possibilities not only entirely like those outside organized life, but in addition surpasses the known laws and possibilities of laboratory chemistry.

From the above considerations may be drawn several important inferences. Every compound not present as such in the food mater-

[1]Burton-Orpitz: Physiology, 1920.

ials, which is necessary to the body in normal functioning, will be formed by the organism's own chemical processes if the elements are present in suitable chemical combinations. Iron compounds have for long been the staple remedies for anemia. In this disease there is a deficiency in the hæmoglobin of the red corpuscles, with or without a deficiency in the number of these bodies themselves. Iron is one of the necessary elements for hæmoglobin. It was assumed that by the administration of the inorganic iron compounds the deficiency of that element was provided for. It has been definitely proven that the iron thus administered passes through the body practically unchanged and unassimilated. But the practice of administering the iron is still too prevalent. Note the fact: the fault is not one of a limited source of iron but a limited power of assimilation of iron. The food materials of an ordinary diet contain enough iron as well as other elements for all normal functioning. Increasing the amount of iron even though it may be assimilable in such form as it is given, which is doubtful, must of necessity fail as a remedial measure. The organism builds up from the food materials all those iron compounds necessary in the composition of hæmoglobin. It has recently been contended that arsenic in small amounts is a constant constituent of certain of the tissues, and from this was derived the assumption that the giving of arsenic in certain diseases, long a thing of practice, had thus found its justification. Reasoning could be no more faulty. The argument against iron in anemia holds equally against the use of arsenic. In both of these cases, if a deficiency in the assimilation of the substance be the real condition, then the logical consideration would be the determination of the faulty condition of the part which prevents the organism itself from selecting and utilizing those substances which are found in sufficient abundance in the blood.

Another important deduction is this: when unusual conditions arise which demand unusual compounds, the latter are formed, provided the necessary elements and a correct adjustive mechanism are present. Hemorrhage is self-limited in most cases. Why? Fibrin, not found in blood under ordinary conditions, is immediately formed from the interaction between thrombin and fibrinogen which are present either actually or potentially in the blood, on exposure of the latter to air or other foreign substance. Thus the clot is formed and further hemorrhage prevented. Why are indi-

viduals immune from certain diseases? In some cases by a so called natural immunity which presents elements in the blood and tissues antagonistic to infective agents. In other cases through the excessive activity due to a previous attack whereby an increase in the neutralizing substance was brought about. What is the source of lactose? It is a sugar found only in connection with the secretions of the mammary glands, generated from the stimulus associated with the pregnant and lactation periods.

Further instances might be supplied but the point is sufficiently plain. The body organism by virtue of its ability to act and be acted upon is continually meeting new conditions as they arise and responding in a manner which insures its continued activity as a separate and self-sufficient organism in a world of contending organisms and inanimate forces. Through its physical, chemical, and vital activities, aided by a favorable medium, it is enabled to maintain successfully an identity given to it by a long line of ancestors and at the same time yield sufficient variation in its less important structural and functional details to prevent disintegration.

CHAPTER IX

THE ENERGY OF THE BODY

The suggestion that man is a machine gives rise to a consideration of the nature and source of the energy that must of necessity be associated with the machine. As already indicated one of the characteristics of the machine, whether it be animate or inanimate, is its ability to convert one form of energy into another. So far as is at present known no creation or loss of energy is possible. This law of the conservation of energy is one of the most fundamental and significant of the laws made emphatic during the last century. It is no less true of the living body than of other mechanisms and other worlds, that the various manifestations of motion are but the different forms into which the one universal energy may be changed from time to time.

Nature of Energy

What is energy? Authorities differ in details, but it is agreed that kinetic energy may be provisionally considered as some manifestation of motion. Dr. Still has emphasized the triune nature of the body in his discussions of "matter, motion and mind." Matter is inert in so far as it may be independent of motion. But matter cannot be independent of motion and manifest itself to the senses. The two are one and inseparable. The motion of an atom is an integral part of the conception of an atom. As soon as matter becomes separate from motion the universe as such must cease to exist. We know that appearances are continually changing. We know that change is a law of nature. And change is only possible through the numerous forms of energy that are associated with the substance of which all things are composed. We may conceive of mass motion, and molecular motion, and atomic motion. These are in all likelihood different phases of the same great energizing principle which lies back of the manifestation. All are concerned with the one inherent property of all matter—that which we denominate energy.

(Since these paragraphs were written, our understanding of this

"great energizing principle" has been somewhat broadened by investigations into the relations of electrons, the constituent parts of atoms, the nature of etheric radiations, and many other aspects of the physical and chemical sciences.)

It has been said that energy remains the same in essence. How is it that it appears so different under different circumstances? This makes necessary a consideration of a corollary to the proposition that energy is never lost or created, and that is, that there is a continuous transformation of energy. This capacity for transformation depends upon the circumstances and composition of the matter with which the energy is associated. Any mechanism which is able to cause a new appearance in the manifestation of energy is a transformer, not a creator of energy. The human body, as all living bodies, is such a transformer. The proposition may be illustrated by several instances.

Chemical Action

One of the forms which energy assumes is that of chemical action which may be considered as an attraction between atoms. It is needless to do more than to call attention to the fact that body functioning is largely dependent upon the attraction that thus exists. The source of such energy is ultimately from the external world, i. e., from the food materials taken into the body and from the potential capacities of the living cell which were transmitted to it from its parentage. Of the latter it is, as yet, necessary to assume an inherent governing force which inaugurates the various changes of a chemical nature with which the embryological processes are associated. Such changes constitute a transformation of potential into chemical energy. But the chemical energy thus initiated further assists cellular activities in which new energy is shown, and a retransformation appears. The food materials taken into the alimentary canal represent immense quantities of stored chemical energy. As this material comes in contact with certain other substances in the canal which are the product of other cellular action and chemical factors, the potential energy of the food mass becomes kinetic in the liberation of new chemical action and heat. The oxygen taken into the body through the membrane of the air cell passes into the blood, is carried to various parts of the body, unites with the carbon of the food and of the body tissue, and in the

chemical changes thus inaugurated heat is set free. In the finer processes of assimilation and dissimilation the same changes and reverse changes are produced through the continuous interaction of the chemical and vital activity.

Molecular Relations

There is a cohesive force associated with body action. This may be spoken of as molecular attraction. Every molecule seems to have an attractive, or a repulsive, effect on every other molecule. This is true whether the substance in or of the body be solid, fluid, or gas. The constant intermixing of the fluids of the body in the processes of diffusion and osmosis presents opportunity for varying relations between the molecules of the different substances. By virtue of this action a continuous interchange between parts of the body becomes possible, and considering the fact of protoplasmic continuity it becomes doubly significant as a factor in body metabolism. The difference in gaseous pressures between the oxygen of the air in the alveoli and that in the blood explains in part the presence of oxygen in the blood; the chemical attraction of hemoglobin for oxygen is also important. Similarly the excess of the carbon dioxid in the blood with reference to the amount in the lung spaces provides a means for excretion of the noxious gas. In the process of molecular action and interaction new conditions favorable to different atomic affinities arise and new compounds are constantly produced.

Gravitation

The energy of gravitation while not strikingly operative in the body is responsible for certain actions that there take place. This energy may be referred to as the attraction between masses, and while it undoubtedly exists in the case of different masses of the body tissue it is insignificant as compared to the attraction between the body and the earth. In this connection it is interesting to note the fact that the urinary apparatus of the human body is so situated as to take advantage of gravitation, and by virtue of this fact alone the kidneys are in large part constantly drained of their excretions; while in most of the lower animals gravitation is made use of in the discharge of excretions from the body. Molecular and chemical movements occur in opposition to the

force of gravitation with a consequent production of new forms of energy such as heat and electric action.

Friction

The mechanical energy of pressure, friction, and change of shape associated with the different parts of the same substance are very manifest in the body and in its relations to the external world. By virtue of the continuous movement of the body parts and the movements associated with environment, pressures and friction occur with the resulting liberation of heat and other forms. The friction of the blood upon the vessel walls accounts in part for the resistance to the blood flow which is so necessary to a normal blood pressure. This friction invariably produces additional changes in form, and as a result heat and electric and chemical action appear. The mechanical pressures of external matter and internal matter upon nerve terminals and less responsive protoplasm, produces impulses which are nervous or muscular in character, either directly or through an intermediate chemical energy which is in turn converted into a nerve impulse. The latter acting upon the stored materials in the nerve cell body is rechanged into chemical and vital energy which will thence further the chain of action. Mechanical energy acting in the nature of a stimulus is of prime importance to the osteopath. For it is largely through the influence of pressures that he is able to explain the various effects from mechanical displacements of tissues constituting the lesion which is the most important cause of disease.

Heat

In a special kind of molecular movement is seen another form of energy with which the body is associated and which is denominated thermal energy. This is spoken of as a molecular vibration the increase of which explains the condition of a rising temperature, the total absence of which constitutes the absolute zero point. That a certain heat level is necessary to body functioning is evident not only from experimental observation but from the known remarkable apparatus present in man which maintains that level in spite of a fluctuating temperature of environment. This form of energy is derived to some extent directly from the external world through the medium of radiation from the sun and other warm bodies, and from the materials taken in through the alimentary and respiratory

tracts in the form of warm food and air; but in large part the heat energy is indirectly derived from chemical energy the source of which has been already indicated. Practically every chemical action is associated with the liberation of heat, although in most anabolic processes the consumption of heat is in excess of its liberation. Of the chemical actions concerned with the liberation of heat oxidation processes are by far the most important. The amount of oxygen consumed in the course of twenty-four hours amounts to 700 grams or nearly twenty quarts per hour. This is suggestive as indicating the immense amount of exidation that takes place in the body. While it is thus true that the heat is in large part derived from chemical action together with that resulting from mechanical energy of friction and movement, it is also true that a transformation back into chemical and mechanical energy takes place to an extreme degree. One chemical change liberates energy in the form of heat. This heat, by furnishing a normal medium initiates new chemical change, and is in other cases perhaps converted directly into muscular and other movement. Throughout the various metabolic processes these continuous transformations are manifest.

Light

Photic energy is essential to life processes. Light has been defined for lack of more definite knowledge as ether vibration. This vibration is ultimately essential to all life processes. The chief, if not the only source of the synthesis of proteid, carbohydrate, and fat is the cell of the living organism. From the plant the animal gets its food material ready made. But in order that the plant shall be able to effect this synthesis light is necessary. Through some power seemingly associated with the chlorophyll bodies the plant is enabled to utilize sunlight in the chemical process concerned in the formation of foods from inorganic materials. But it is not alone in this indirect way that light is essential to animal life, for observation shows that individuals living in an environment of greater or less deprivation of light become abnormal in their functioning. This fact suggests the necessity for looking to the environment of the individual for the preservation of normal health, and from this fact has arisen the light cure by which it was hoped to overcome disease conditions through an excess of the energy, a certain amount of which is essential. An excess of any force or

factor is never logical as a method of cure. That an excess of light is deleterious there is sufficient evidence to show. Ordinary sunburn in fair skinned individuals is a pathologic condition as also are the burns from X-ray applications. Individuals working in factories where light is generated or in other conditions where an excess of light is present suffer from various forms of cutaneous and other disorders.

Light is further a normal stimulus for the function of sight. In this case the ether vibration coming into relation with the pigmentary layer of the retina is transformed into chemical energy which influences nerve terminals and which in turn results in the definite subjective sensation. Whether in the human body light is produced from transformation of other known forms remains to be proven. In the case of certain of the lower and especially of marine animals, chemical action or other energy is quite appreciably transformed into light.

Electricity

Electric energy is undoubtedly associated with a large number of body processes. In the experimental laboratory it can be shown that both chemical and mechanical energy may be transformed into electricity. It is probable that similar conditions in the case of the living organism are responsible for the electrical manifestations known to be present. It is known that in conditions of activity and of pathology a difference in electric potential exists in muscle such that the active and the resting state are electrically opposite in sign, which is also true of the normal and the injured tissue. This becomes of special interest in view of the recent investigations into electro-chemistry. The investigation into the electric conditions of the body has only begun and the further results are awaited with much interest. Dr. Still continually assumes the presence in normal as well as abnormal conditions, of a force of an electric or magnetic nature, and no demonstration to the contrary has yet shown that he is wrong, while what experimental evidence is available suggests that he is correct. The fact that such currents exist has given rise to numerous attempts to make use of the fact in a therapeutic way, but thus far electrotherapy has proven as unsatisfactory as the drug, and for the reason that the electrical conditions of the living organism still remain far outside of human understanding.

Nerve Energy

With reference to nerve energy, little can be said. Its fundamental importance is obvious and will be continually referred to. What it is we know not. It may be measured in its rapidity, it may be judged by its effect. Whether it be electrical or chemical or neither we can not at present say. Mechanical force, chemical action, light—all may influence its action and assist in co-ordinating its impulses. It is unique among the body forces and to the physician presents a most interesting field of study. When its ultimate nature is once known and its manifestations and variations understood, much will be done toward explaining the numerous facts of body functioning and a long stride will have been taken toward the solution of many vexed problems in osteopathic practice.

Energy Balance

In connection with the above considerations the following table modified from Hall's Physiology is suggestive. Note that the energy of the body finally is given off largely if not entirely in the form of heat. Owing to the fact that the latter is fairly subject to measurement, approximations of energy expenditure can easily be determined.

Balance Sheet of Energy for Man at Light Work.

	Inc. in Cal.	Exp. in Cal.
Income:		
Proteids .....110 grams at 400 calories	440,000	
Fats .....100 grams at 9400 calories	940,000	
Carbohydrates .....400 grams at 4180 calories	1,672,000	
Expenditure:		
Mechanical work reduced to calories.....		500,000
Excreta loss (1900 grams).....		47,500
Warming of inspired air.....		84,500
Evaporating 660 grams perspiration.....		384,120
Evaporating 330 grams H_2O from lungs.....		192,600
Radiation and conduction from skin.....		1,843,280
	3,052,000	3,052,000

Thus far the fact has been emphasized that energy in various forms is fundamental to the life processes. It should be understood that in some forms of energy it may exist either as potential or kinetic, as latent or active, and that these are interchangable. The combination of the molecules and atoms in foodstuffs represents potential energy, which, on coming into relation with certain environments furnished by the body, is converted into the kinetic

energy of chemical action and heat. The free molecule of oxygen in the plasma of the blood, by virtue of its chemical affinities has the power to unite with carbon and other elements and substances with the transformation into the kinetic energy of chemical action and heat. The stored glycogen and related compounds in the protoplasm of muscle substance represent potentially the activity that becomes manifest as mechanical energy on the application of a stimulus. The stretched condition of the aortic wall immediately following the systolic discharge is potential energy which immediately becomes active in a recoil through its elastic property.

Summary

Summarizing the foregoing and making a definite application, it may be stated that a normal condition of health is dependent on a proper co-ordination of energies, and that disease represents a condition of living matter such that inco-ordination results. If the nature of muscle tissue is such that its potential energy requires an excess of stimuli to be converted into a kinetic manifestation, then abnormality exists. If a nerve cell body is in a state of hyperexcitability due to disorders of its nutrition, the condition is a too ready response to a stimulus with resulting change to a kinetic form. Further, these transformations all represent normal stimuli to body action. Life processes consist largely of response to the stimuli of a continuous stream of impulses that pass by countless different tracts from periphery to center. If the external or environmental changes are too rapid or intense for a normal response, or if the organism is in a condition which prevents a sufficiently rapid assimilation of energy and its proper conversion, disorder must result. In the former the fault lies with the environment and is a cause of disease which in another section is classified as an abuse of function. In the latter the condition will usually be found dependent on a condition of impaired structure which modifies the processes necessary to a proper co-ordination of energies. When through lesion to the digestive apparatus a deficiency of gastric secretion exists, the balance between the potential energy of the food and that of the gastric juices is disturbed. Hence disturbed chemical transformation results. Through a fault of the organic structure the heat regulation mechanism may become deranged and an excessive chemical action with heat liberation result with

a consequent rise in body temperature. This rise in temperature furnishes the occasion for further excessive transformation and a chain of effects may follow. An injury to a muscle initiates chemical changes excessive in kind or degree, and a considerable difference in electrical potential is produced. as well as other important changes. These various effects of the injury ultimately result in inflammatory changes, and these, in turn, tend to bring about a return to normal structure and function. If the injury is not too severe, and if other conditions of the body are normal, recovery may be almost or quite complete. The continued absence of any normal stimulus from environmental change, such as light, results in a loss of energy transformation which is dependent upon such stimuli, and a general weakness in consequence.

With the action and interaction of matter and motion, then, and all under the superintendency of a guiding force, call it mind, vitality or what not, the normal body metabolism will be maintained in harmony with itself and with its environment. Through long ages the organism has been subjected to certain environmental conditions by which it has become adapted to all ordinary and to numerous extraordinary circumstances. In such adaptations of energy is seen one of the most remarkable facts of living tissue.

CHAPTER X

BODY FUEL

The principal source of the energy of the organism is the food materials. It is manifest that for a proper transformation and utilization of energy there must be a sufficient quantity and quality of the food to be disintegrated to yield the necessary forms. As an engineer insists on a good quality of the fuel as a prerequisite to a full capacity in the performance of his engine, so the human engine must be supplied with materials appropriate to its needs. From analysis of the body substance and from experimental observation it has been determined that there are certain organic and inorganic materials which are essential to normal body functioning. Among the former are proteids, carbohydrates and fats; among the latter, water and several salts, more especially sodium chloride. Three or more substances of a nature not yet well understood, called vitamines, are also essential to the maintenance of good health. Numerous other salts are found in body tissues but are present in sufficient abundance in the organic foodstuffs to make it unnecessary to supply additional material. Indeed, evidence is accumulating to show that except in the form of these complex organic substances these various inorganic salts will not be assimilated. Bunge, in speaking of the value of lime salts makes this interesting observation: "Lime is found combined in organic substances in food; it is therefore irrational to prescribe lime for children in the form of inorganic compounds. In medical practice rickety children are constantly being ordered a couple of teaspoons of lime water. This is useless because the amount ordered is far too small. A saturated solution of lime contains less than cow's milk. In a pint of cow's milk I found 1.7 grm. CaO; a pint of lime water contains only 1.3 grm. CaO."[1] The legitimate deduction is that two teaspoonfuls of cows' milk would be the better prescription! It is true that the addition of lime-water to cow's milk forms a basic calcium caseinate which cannot be acted upon by rennin; thus the usual tough curds of cow's milk are avoided. It is, how-

[1]Bunge: Physiologic and Pathologic Chemistry.

ever, very probably true that this action interferes with the nutritious qualities of the milk, and that the use of limewater for this purpose is harmful to the child.

The function of the inorganic salts is in large part the regulation of the medium in which organic foods may be stored, transported and assimilated. Thus Thompson suggests the following functions: "To regulate the specific gravity of the blood and other fluids of the body; to regulate the chemical reaction of the blood and the various secretions and excretions; to preserve the tissues from disorganization and putrefaction; to control the rate of absorption by osmosis; to enter into the permanent composition of certain structures, especially the bones and teeth; to enable the blood to hold certain materials in solution; to serve special purposes, such, for example, as the influence of sodium chloride on the formation of hydrochloric acid, and that of lime salts in favoring coagulation of the blood."[1]

Water

Water is an absolute essential and must be taken in greater quantity than is present in the solids of an ordinary diet. Its functions are largely secondary to those of the organic foods but none the less essential. The very fact that about sixty per cent. of the body is water indicates its great value. Attention was called to the fact that the essential life substance—protoplasm—is largely fluid, and for specific purposes. This fluidity is dependent on the presence of water. The following may be enumerated as the more important uses of water to the body organism: solvent, diluent, medium for transportation, stimulant, and as a thermolytic agent. Unquestionably there are individuals who take less water than is essential to a normal functional and structural condition.

Proteids are the most essential of the organic substances. It has been shown by Pfluger and others that in case of the dog, of the organic foods proteid alone is sufficient to maintain life, while the absence of proteid material in the food is immediately disastrous to normal function and soon results in death. In general the statement is true that proteids are the tissue builders while carbohydrates and fats are energy producers, and are oxidized with the liberation of

[1]Thompson: Practical Dietetics.

heat. In the absence or deficiency of the latter two, proteid may be converted into sugars and fats. In addition to these comparatively simple requirements, vitamines and other substances, apparently not either tissue-builders or energy-providers, are essential to normal nutrition. The exact place of these substances in bodily economy is not yet (1922) well understood.

Metabolism

With the finer processes of metabolism we are of necessity much in ignorance. What takes place in the transformation from non-living to living proteid cannot be known except in the more gross details. This is undoubtedly true, that only those substances which are concerned in tissue building, secretion, and energy transformation will be permitted to remain in association with the living protoplasm. In this connection Dr. C. M. T. Hulett has emphasized the fundamental fact when he says, "The chain of events in metabolism is a closed chain and into this metabolic cycle no substances but those that serve as food can ever enter. Material not suitable for its upbuilding cannot be imposed upon living substance. It will take in only food elements and only such quantity of those as its needs determine, without regard to the supply which might be available. The only way in which other substances, as drugs, can become incorporated with living substance is by destroying it. Acids and poisons unite with it in that way. The constituent events of the metabolic cycle do not follow each other in a single line but in many lines. Pfluger has emphasized the importance of the polymerization of the proteid molecule in growth—assimilation, in living substance, in which the simple molecule takes in from the materials of the environment, atoms of food elements, attaching them to itself until it becomes a polymeric molecule. It then breaks down into simple molecules, each of which repeats the process for itself, again and again, forming in that way numbers of chains of many similar links. Dissimilation is the reverse of this process, the end products being principally water, carbon dioxide, and urea. The successive chemical reactions in each chain or line have been compared to explosions on account of the great lability of the compounds."[1]

[1] Journal of the American Osteopathic Association, Nov., 1901.

Selection

By the process of selection which is a characteristic attribute of living protoplasm, every particle of the latter and every normal cell takes or rejects the materials furnished to it by the blood or lymph. In a similar manner it throws out from its substance into the blood or lymph every material that is of no further use to its functioning. This is true of the substances that are formed from cell katabolism but is usually true also of those foreign elements which have temporarily gained access to the protoplasmic substance. In order that the two processes—selection of food materials and the rejection of waste—may be correctly balanced the medium for transportation must be normal in kind and quality. The lymph must contain sufficient available material from which the cell may select and must be in such a normal condition of osmotic pressure and chemical activity as to offer no serious hindrance to the exchange of waste for nutritive substances. This manifestly depends on a normal condition of the blood both with reference to quality and quantity. Since the blood itself is manufactured within the body, from materials delivered from the food, the necessity for a proper diet becomes at once apparent.

Reserves

It does not follow from the above considerations that every change in the dietary conditions will immediately or remotely produce a disturbance in the protoplasmic exchange. For, note that there are large possibilities of reserve supplies between the cell and the digestive tract. The cell itself is capable of carrying on its functioning for an appreciable time even though the blood be totally removed. This is true because it is a function of the cell to store an excess of food not immediately needed. In every cell under ordinary conditions there are fat droplets, glycogen, and other reserves which in addition to its own substance will be drawn upon as the needs require. In the lymph and blood and in the intercellular tissues there are immense quantities of stored material. The liver stores glycogen abundantly. The fat of the body provides a great reservoir of potential energy. This explains the fact that the organism may fast for weeks with little impairment of function

though there will be an appreciable loss of substance, chiefly of those structures and organs which are not immediately necessary to life.

Diet

What are the essentials in a diet? The science of dietetics is still in a condition of chaos. Analysis of the body tissues and secretions have thrown some light on the problem. Note this fact: the chemical composition of a foodstuff is not a sufficient criterion for judgment as to its value to the organism. If this were the case the food supply of the world would become a question of laboratory synthesis. The various elements must be in a definite condition of combination. Further, not all combinations seemingly alike in their various characteristics are equally available to the organism. Starch and cellulose are similar in composition but the latter is nearly indigestible. Various of the prepared foods, while containing all the elements and compounds in proper proportion, have been found deficient in their nutritive value. The condensed foods, peptonized and otherwise predigested foods, are not suitable for ordinary conditions. The decrying of white flour and extolling the whole wheat variety was the fashion among the dietarians a few years back. Chemical analysis had shown that the whole wheat contained the essential organic foodstuffs in more nearly a correct proportion than did the white. Yet analysis of the feces shows that the proteid in the husks and outer part is much less available and hence in large part of no use to the organism except as a stimulant to peristalsis. The vitamines, whose nature is not yet known (1922) are essential to growth and to health.

With the average diet available to the ordinary American the organism is amply able to extract sufficient of the nutritive principles to maintain bodily vigor. Statistics with reference to different people and different climates are illuminating more in that they show that what is chemically a very deficient diet is actually and physiologically a very sufficient one. The Esquimaux with his tallow and the Chinaman with his rice do not show sufficient differences from those subsisting on a more varied diet—explainable alone from dietetic conditions—to make it a safe rule to rely upon chemical analysis alone for judgment of food values.

Proteid Requirements

Well-nourished nations eat, on an average, about one hundred grams of proteid foods each day for each grown person. It has been shown experimentally that a grown man can do active work, and remain in nitrogen equilibrium and in good weight and good health, upon a diet containing one-third of this amount. It has been supposed by many recent authors (1922) that protein extravagance may lead to renal, hepatic and intestinal disturbances, and to various types of toxemia.[1]

On the other hand, there is great danger that in reducing the consumption of proteid foods, and especially in reducing the variety of proteids used, there may be serious reduction of the factors of safety. Under the experimental conditions, men are not subjected to undue strains, nor to infections, nor to emotional or other conditions of stress such as are inevitable in ordinary life. A broader study of entire peoples or families, especially since the Great War, shows rather distinctly that any constant and marked deviation from the proteid intake of about 100 grams per day per grown person is associated with diminished resistance, diminished mentality and enthusiasm, and increased tendencies to toxemias, renal and hepatic diseases, the very diseases which have previously been ascribed to the protein excesses.[2]

Palatability and Idiosyncrasy

The question of palatability must be considered. Cooking, condiments in reasonable amounts, flavoring materials, and pleasant surroundings add not only to palatability but also to the digestibility and the nutritive qualities of foods. These factors must all be taken into consideration in connection with the treatment of poorly nourished individuals.

In connection with the above Professor Atwater says: "Digestability is often confused with another very different thing, namely, the agreeing or disagreeing of food with the person who eats it. During the process of digestion and assimilation the food as we have seen, undergoes many chemical changes, some of them in the intestines, some in the liver, muscles, and other organs. In

[1]Lusk: Science of Nutrition.
[2]McKillop: Food Values.

these changes chemical compounds may be formed which are in one way or another unpleasant and injurious, especially if they are not broken down (as normally they are) before they have opportunity thus to act. Some of the compounds produced from the foods in the body may be actually poisonous."

"Different persons are differently constituted with respect to the chemical changes which their food undergoes and the effect produced, so that it may be literally true that 'one man's meat is another man's poison.' Milk is for most people a very wholesome, digestible and nutritious food, but there are persons who are made ill by drinking it, and they should avoid milk. The writer knows a boy who is made seriously ill by eating eggs. A small piece of sweet cake in which eggs have been used will cause him serious trouble. The sickness is nature's evidence that eggs are for him an unfit article of food. Some persons have to avoid strawberries. Indeed, cases in which the most wholesome kinds of food are hurtful to individual persons are, unfortunately, numerous. Every one must learn from his own experience what food agrees with him and what does not."

This question of personal idiosyncracy concerning foods is an interesting one. In some cases it seems to depend upon distaste, and this, in turn, upon unpleasant emotional associations. In other cases it seems to be due to improper functions of the digestive organs. Such cases often lose the idiosyncracy after receiving osteopathic treatment and the correction of lesions affecting the digestive tract.

Dietetic Habits

The time for eating or the frequency does not exercise as great an influence upon body conditions as one is led to think by numerous so-called health journals. True, one may eat so often as to prevent recuperation between the periods of activity of the digestive apparatus. The frequent eating of small amounts of food is not necessarily bad practice and may be an adequate method of meeting certain abnormal gastric conditions. Overloading under any circumstances is objectionable. An abrupt change in dietetic habits is of more importance as a cause of digestive trouble than is the particular habit of the individual.

Eating in Disease

With disease conditions present the viewpoint is somewhat changed. Yet we are largely in the dark with reference to the dietetic principles to be employed in particular cases. In most cases appetite is a safe guide in health and within limits it is also in disease. Very few cases present themselves where it is advisable to force an individual to eat against his own desire. "Just a little to keep up strength" is advice and practice which is accountable for numerous prolonged disorders. The patient's desire will usually indicate the time. But it is equally faulty logic to withold nourishment long after the appetite has returned. Fasting for ten, twenty, thirty days is advocated by various physicians, many of whom rejoice in the reputation of following all methods of treatment that are natural! Excesses are always unnatural, and the substitution of one abnormal condition for another is never logical and is rarely advantageous. The individual may get well, but the result is only another of the indications that the organism may regulate its function even under adverse circumstances. Like surgery, the long fast is sometimes a useful method of treatment.

CHAPTER XI

A SELF-SUFFICIENT MACHINE

While it is necessary to make emphatic the fact that the human body is machine-like in its structure and operations it must not be forgotten that it is far more than a machine in the usual sense of that word. It surpasses the ordinary machine in the fact that it is self-feeding, self-oiling, self-operating, and self-regulating.

By virtue of the facts emphasized in the previous sections the body organism is enabled to care for itself, so long as it is supplied with normal diet and environment, for its natural duration of life. The importance of this idea is such that it will be considered at some length. If it were asked what fact is most striking and most fundamental in the osteopathic philosophy, we should unhesitatingly affirm, the self-regulating power inherent in protoplasm. At the outset it must be noted that the organism's power of self-protection is not unlimited. While from one viewpoint it is preferable to consider all things as co-operating for the ultimate good of each other rather than as a life-and-death struggle for existence, yet the latter condition undoubtedly does represent one of the tendencies of all nature. Hence it is presumptuous, in view of known facts, to assume that the body organism will triumph in all its encounters. But the fact that it is sufficient for ordinary conditions of environment and for numerous and extreme emergency conditions must be emphasized by a few illustrations.

In Health

1. It is self-sufficient functionally in health. Note an illustration in the mechanism of circulation: the stomach on the ingestion of food needs an increase of blood. The food materials act as a stimulus to certain nerve terminals in the gastric mucosa; afferent impulses are sent to a nerve center in the spinal cord where efferent impulses are generated, resulting in a dilatation of the gastric arterioles; the general blood pressure remaining unaltered, an increased blood flow to the stomach is inevitable. In respiration: by reason of an increase in metabolism, an excess of carbon dioxid is generated and modifies the normal condition of

the blood; that excess acts as a stimulant to certain nerve cells located in the medulla; these generating efferent impulses over the nerves controlling the respiratory apparatus cause an increased activity of that mechanism whereby the excess of carbon dioxid is eliminated. In heat regulation (thermotaxis): the individual is exposed to a sudden lowered external temperature; by nerve influence and direct effect superficial vaso-constriction and deep vaso-dilation occur, the individual shivers, draws his limbs closer to his body; hence not only a lessened opportunity for heat loss but through several media an increased metabolism results, which means the maintenance of the average body temperature within narrow limits. Protection against poisoning from toxic materials produced in normal metabolism, is strikingly illustrated in the case of the conversion of ammonia which is quite poisonous into urea which is much less so, by the cells of the liver. In vomiting is seen an example of an emergency function exemplifying self-regulation; an irritating substance is taken into the stomach which, acting as an intense stimulus on terminals of the vagus nerve, causes afferent impulses to pass to the vomiting center in the medulla; efferent impulses sent out over the vagus, the lower intercostals, and the phrenic, cause a forcible expulsion of the irritating materials, at the same time through other mechanisms the orifices of the stomach are co-ordinated, the glottis closed, and anti-peristalsis of the esophagus occurs. In the depressor nerve another emergency function is provided for; under ordinary conditions of blood pressure that nerve is inactive. When by reason of increased peripheral resistance or other cause the pressure becomes excessive, terminals of the nerve in the walls of the ventricle are stimulated, efferent impulses are sent to the vaso-motor center and general and special dilation occurs with a consequent lowering of pressure.

In Disease

But also in disease conditions we note the regulation. In the high temperature of the body we have a condition unfavorable to the development of micro-organisms which are known to be associated with various fever states. High temperature is brought about by the disturbed condition of the body, the excess of waste producing a condition of toxity, which acts as a stimulus to an excessive metabolism resulting in an overactive oxidation. In great part the rise

in temperature results from a lessened heat loss through peripheral vaso-constriction. The heat thus generated acts not only in the manner suggested above but assists in ridding the body of foreign and waste material by burning it. The spirilla of recurrent fever lose their mobility at 40° C. (104° F.); the most favorable temperature for the tubercle bacillus is 37°-38°C. (99.5 °F.) the propagation of the streptococcus erysipelatus is terminated at 40°C. (104°F.) and the organism is killed at 41°C. (105.8°F.)

Slosson has shown that leucocytes move with increased activity, and engage in phagocytosis more efficiently, when the cells are kept at a temperature of 99° to 103°F. Their efficiency in destroying bacteria and in removing foreign materials is thus greatest in mild fevers.[1]

In convulsions, according to Dr. Still,[2] is represented an effort to overcome a disturbance in the equilibrium of certain of the vital forces. The increased activity of the skin in disturbed renal conditions represents an emergency function as well as an example of the substitution power of the body organs. In infection the white blood corpuscles are increased in number and efficiency as a result of some stimulus dependent on the presence of pathogenic bacteria; while in addition to this function of phagocytosis of the white blood cell an increased antitoxic condition of the blood and tissues is produced dependent on the same factors.[3]

Starvation

In starvation the body is preserved in a remarkable manner, for

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[1]Jane Slosson, A.O.A. Jour., July, 1917.

[2]Still: Philosophy of Osteopathy.

[3]Stern and Korte (Berl. klin. Wochen., 1904, No. 9, p. 213), by using a method devised by Neisser and Wechsberg, have measured the bactericidal power of the blood serum of typhoid fever patients and of normal individuals. To fixed quantities of fresh unheated rabbit serum and a dilution of twenty-four-hour bullion culture of typhoid bacilli varying amounts of heated typhoid serum were added. After the mixture had remained at 36.5 C. for three hours the whole was plated. The authors find that almost complete bacteriolysis takes place, even when typhoid serum is used in very high dilutions. In a few cases the serum, when diluted 50,000 times, is still active. Sera from persons who have not had typhoid fever possess a much lower bactericidal value, and usually are only effective in dilutions of 1:200 or thereabouts. No relationship can be made out, either between the severity of the disease or the tendency to relapse and the bactericidal value of the serum. Neither does there appear to be any direct connection between the agglutinating power of the serum and its bactericidal action. Sera diluted beyond the agglutinating point are still bactericidal.—American Journal of The Medical Sciences, June, 1904.

not only are stored foods—glycogen, fat, etc.—first drawn upon, but when the source of supply becomes exhausted the organs least essential suffer first. The following table from Stewart's Physiology, giving percentages of total organ weight lost in starvation is suggestive:

Brain	3	Kidneys	26
Heart	3	Blood	27
Bones	14	Muscles	31
Pancreas	17	Testes	40
Intestines	18	Liver	54
Lungs	18	Spleen	67
Skin	21	Fat	97

During fasting, there is usually a tendency to assume the reclining position, to avoid exertion, and to pass many hours in sleeping. There is usually also a feeling of chilliness, which causes the patient to seek warm places and to wrap himself in warm clothing. All of these factors protect the body from loss and prolong life.

Structural Relations

2. It is self-sufficient structurally. Note the calloused condition of the palms in the case of an individual who performs much manual labor; or the similar hardening of the gums of those who are without teeth—structural change because of functional increase. The body is continually meeting with mechanical forces sufficient to temporarily displace parts, e. g., the ribs, in which the normal tension of muscle and ligament is usually sufficient to readjust. In case of slight wounds blood and lymph together are able to approximate the parts and secure healing.

But also in disease the regulating power over structure is manifested. When the structural change in the semi-lunar valves permits a regurgitation of blood, the ventricular muscle hypertrophies to correspond to the increased work to be done; in which case we have a compensatory structural change. In dislocation of the hip where tension of ligaments and muscular effort are insufficient to accomplish reduction, compensatory changes occur, such as shortening and lengthening of muscles and formation of a new acetabulum with adhesions for ligaments. In broken bones where continual motion has prevented the knitting process, "false joints" have been formed with all the essential structures, articular surfaces,

ligaments and synovial membranes imitated or formed. In local dilatation of the upper intestine in case of absence of the stomach, and in dilatation of the esophagus after obstruction of the cardiac orifice of the stomach, and in the compensatory development of veins and arteries after other veins and arteries have been destroyed, we have illuminating instances of the ability of the organism to rise to the occasion.

The above facts have been emphasized for the purpose of impressing the fundamental proposition that all processes of healing are dependent on the inherent power of protoplasm; that that inherent power to heal will be exercised so long as structural conditions are normal, and that in the majority of cases where the structural conditions are abnormal, adjustment of the latter is not beyond its power; that the duty of the physician is only to keep external things—things external to function—favorable to the exercising of that power.

CHAPTER XII

THE TENDENCY TO THE NORMAL

The considerations in the last chapter lead to a more definite determination as to the nature of the normal condition and the reasons for such a tendency to maintain or restore that condition. If the question were asked as to what constitutes a normal condition few there are who would not be able to give a fairly satisfactory answer in general terms. But though the general conception were held by each, to explain the specific elements necessary in a normal condition is a task of some considerable difficulty.

What is Normal?

If we answer that a normal body is one in which the different parts are working in harmony we have a satisfactory general answer. But if we attempt to give the several elements a mathematical value and then insist upon measuring every individual by that standard we will certainly meet with insurmountable difficulty. If by careful estimates we determine that 33 grams of urea is the normal amount excreted in 24 hours, shall we call that individual abnormal who excretes only 28 grams? If we determine that 72 beats per minute shall be the standard for heart action, shall we decide that Napoleon whose heart rate was 40 and that others whose rate was below or above the average figures were not normal? In relation to men collectively, then, no standard of normality can be given. But what about the individual? Can we establish a standard for each individual? The difficulties are identical. The individual condition is continually changing in quality and quantity of functioning. The change is no evidence of a departure from the normal. It is the normal that varies and hence an absolute value cannot be given to the various elements constituting a normal.

If we shall make symptoms the criterion of our judgment we shall certainly fail in numerous cases. Many diseased conditions are present for long periods of time though presenting absolutely no noticeable symptoms, subjective or objective. Further, certain changes in appearance ordinarily considered symptomatic of dis-

ease are not so in reality; for instance a rapid heart beat is usually apparent following the climbing of a steep hill. The individual is not subjectively distressed and the objective symptom of rapid heart beat is present. But the actual condition instead of being abnormal is normal under the circumstances. Is pain an abnormal condition? Not necessarily nor usually. Subjectively it is a psychic condition and as such is in one sense a product of cerebral activity. In so far as it is a warning it is a normal condition though it is evidence of some abnormal condition. This is equally true of other subjective symptoms. We cannot, therefore, rely upon symptoms alone as a criterion for judgment of a normal condition. The best that can be done under the circumstances is the determination of the physiological condition of an individual by comparison with the average condition of the average individual under similar circumstances. We must judge the fact or the degree of abnormality according to the presence or absence of symptoms, or of disturbances of function, structure, comfort or mentality, or according to the findings secured by various physical, chemical or functional examinations, since the exact line of demarcation between normal and abnormal is a non-determinable quantity.

Heredity

While it is true the details constituting a normal condition are not confined within known and unyielding limits, the general forces back of the tendency may be determined. In the first place there are two fundamental forces associated with the life of each organism, the first of which is heredity. By the term is meant that peculiarity derived from the total ancestry, that compels a likeness to type. What is inherited? (a) The life principle itself and (b) the structure of the body. It is to be noted that inheritance does not refer simply to the relation between immediate parent and offspring but between the whole line of ancestors and the individual. An individual may present the special peculiarities of his grandsire rather than those of his sire, in which case there is a special quality of germ plasm handed down through the parents but not becoming manifest in them, to reappear in developed form in the grandson. Such a reversion to ancestral characters is technically referred to as atavism or reversion.

Many peculiarities of heredity must be considered. The Men-

delean laws govern certain hereditary factors, and these may determine the prognosis in certain diseases. Hereditary structural conditions may predispose to certain types of disease, or may give comparative immunity to other diseases. The heredity of structure includes structures within the body as well as those visible; includes microscopic structures as well as macroscopic structures.

Variation

The second great force is that of adaptation which has reference to the peculiarity that permits an unlikeness to type—a peculiarity which is dependent on the environment for its manifestation. What varies? The special features and functions. No two individuals are alike in their structural or their functional characters; and this individual variation, in so far as it is not a likeness to some ancestor, is dependent on conditions of environment, i. e., dependent on stimuli acting upon the organism during its separate existence.

Both of the two great forces are necessary; the one in order that stability shall be preserved and the identity of the species maintained; the other in order that the individual shall not be disintegrated because of an absolutely unyielding nature. Each one of the two forces tends to counteract the extreme tendencies of the other and hence the happy medium is maintained. Heredity alone would make an absolute condition necessary to a normal one. No adaptation to the continually arising new circumstances could be possible. Because of the adaptation associated with the living material variation is possible. Hence the boundaries of the field of normal action are markedly widened. Recognizing the two forces it is possible to explain in a general way individual peculiarities, such as a difference in heart beat, in bowel activity, and perspiration; and circumstantial peculiarities, such as increase in respiration dependent on altitude, hypertrophy of the heart in valvular disorders, thickening of tissues in cases of continuous wear.

These conditions become of special interest and fundamental importance to the osteopath especially in their application to the determination of lesions. In a later chapter there is indicated in detail the points necessary to consider in the diagnosis of a lesion but in this connection we wish to emphasize one case. The tendency of the beginning osteopath is to assume that every variation of structure, especially in the position of the spinous process, is a

lesion. The foregoing considerations would suggest some possible exceptions. Experience demonstrates that there are numerous exceptions. The spinous process may be deviated because of an overdevelopment of muscles on one side—the right in right-handed individuals, for example—or from a faulty condition of nutrition in fœtal life, or from various other forces, which while causing an appreciable variation from the average condition does not cause or predispose to disease, and hence could not rightly be called a lesion. What is true of the position of parts is true of the several other conditions that may be present. In all considerations of diagnosis the possibility of unusual appearances being normal must be recognized.

Adaptation

A normal individual is one sufficiently like the species to maintain its identity as a member of that species but pliable enough to change in any part or function sufficiently to meet the average emergencies of environment, without interfering in any way with associated functions. If the incidental forces are sufficiently intense or prolonged to produce a modification beyond the limits of adaptive response disease will result. Otherwise, while function and structure may be temporarily modified, disease beyond the limits of self-cure will not occur. As a specific illustration mention may be made of the effect of a change of altitude. On passing from a lower level to one considerably higher a new condition of environment is represented in the rarer atmosphere. If there were not the principle of adaptation, the organism would soon succumb for lack of oxygen, but possessed of that principle the organism responds by a quantitative change of function. Respiration and heart action are quickened, new red blood cells are rapidly formed, and vital equilibrium thereby maintained. This change of function is not perverted function, for it is normal—necessary—under the circumstances. The normal has varied to meet varying circumstances, and thus normal functions are maintained. Temporarily, the increased function may distress, but permanently other functions are unimpaired. But, if this change of air pressure be extreme, so that the organism's adaptive capacity is overreached, functions are perverted and disease beyond self-cure will result.

This tendency to the normal results in part from certain well known principles which may be enumerated.

1. First are those of a physical nature. Self-reduction of luxations depends to a considerable extent upon the difference in mechanical tension on opposing parts of the luxated structure. In the case of the formation of a new acetabulum the mechanical pressure operates to produce the cavity. The discharge of irritating particles from the bronchi is effected by an apparatus which utilizes air pressure.

2. The tendency may depend upon chemical conditions. The carbon dioxid acts as a chemical stimulus to the nerve cells controlling respiration. Immunity to certain diseases through the medium of an increased antitoxic condition of the blood is secured by chemical means. The coagulation of the blood, thereby preventing its own loss, is largely a chemical process.

3. In many instances the nature of the reaction is not well understood, as in chemotaxis, phagocytosis and many co-ordinating activities.

It is not to be presumed however that these various separate principles act separately in bringing about the adjustment. It is likely that in no case is this true but that many factors are associated and co-ordinated by the organism. And thus continually guarding and restoring, the organism is enabled to pass its alloted existence in a world rife with changes of environment which may at any time be sufficient to inaugurate disease. But by virtue of the tendency exercised both in ordinary and extraordinary circumstances it may usually triumph, and hence it is in a very real sense that the statement is true that "disease is the stimulus of its own cure."

CHAPTER XIII

THE ETIOLOGY OF DISEASE

In a previous chapter it was suggested that health represents a condition of body harmony and that disease is body discord. For purposes of convenience perverted function may be accepted as a definition of disease. While this is not entirely satisfactory in that most diseases are associated with structural changes also, yet the appearances so strongly emphasize the prime importance of functional perversion that use will be made of the phrase. Granting that there are limits to the self-regulating power of the organism and that disease does exist, it becomes necessary to inquire into the cause of disease: and first will be mentioned the most important of two general causes.

Abnormal Structural Conditions

Whatever in addition he may be, man is certainly a machine. It is further obvious that the function of a machine, its action, is absolutely dependent on its structural integrity and that just as soon as any part of the machine becomes disturbed in relation to other parts disorder of action will result. Is this true of the man-machine? It would seem a simple proposition easily answered. Yet objection is offered. Without at this time entering into a discussion of the relative placing of structure and function, a few facts may be indicated tending to prove indisputably the contention that the abnormal structural condition is a frequent cause of perverted function.

Gross Lesions

Medical history teems with records of cases where at least gross anatomical disturbances indicate definite and far-reaching physiological disorder. A few such will be specified. A dislocated hip or a subluxation of the sacro-iliac articulation, or a lumbo-sacral subluxation, will cause sciatica. How does it do so? By direct pressure, not necessarily on the nerve, perhaps, but upon structures closely enough associated with it—its blood supply, for example—to result in its disorder. Note the statement of Church: "Compression of the nerve in sitting or by vigorous action of the leg-

flexors and rarely contusion from blows below the sciatic notch may induce it.''[1] Strumpbell refers to ''neuralgias secondary to trauma and compression.''[2] A dislocated cervical or even lumbar vertebra will cause paralysis by pressure upon the spinal cord or upon its sources of supply. Scudder refers to cervical conditions in this manner: ''The most common form of cervical dislocation is that occurring upon one side, and is usually without fatal result. This is rather a common injury. It is often unrecognized.''[3] An occluded blood vessel may cause gangrene. Note Nancrede's statement: ''Indeed except when the traumatism physically disintegrates tissues as a stone is reduced to powder, heat or strong acids physically destroy structure, or cold suspends cellular nutrition so long that when this nutrition becomes a physical impossibility vital metabolism can not be resumed, gangrene always results from total deprivation of pabulum.''[4] He also indicates that most surgeons assert that the moist form depends in part upon interference with drainage. According to many authors and investigators, including the renowned Virchow, the gastric ulcer is caused by a disturbance of the circulation by embolism or other occlusion or obstruction. A flat chest vitiates lung tissue and renders it susceptible to invasion by bacteria. Pregnancy by pressure on renal vessels produces albuminuria. Sclerosis, overgrowth and hardening of connective tissue structure, causes paraplegia and similar conditions. Tachycardia may be caused by pressure paralysis of the vagus nerve from ''tumors, aneurism, enlarged lymph-glands, * * * * in the neck or the thorax.''[5] A sprained ankle causes congestion and infiltration, thereby producing various sensory and motor disturbances directly and reflexly. And finally, ''the movements of the muscles of the neck, by pressing on the jugular vein, are sufficient to affect the cerebral circulation.''[6]

Lesions of Less Degree

In all the cases mentioned above we have illustrations of the fact that function depends on structure. That such cases exist is

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[1]Church and Peterson: Nervous and Mental Diseases.
[2]Strumpbell: Text-Book of Medicine.
[3]Scudder: The Treatment of Fractures with Notes upon a few Common Displacements.
[4]Nancrede: Principles of Surgery.
[5]Anders: Practice of Medicine.
[6]Schafer: Text-Book of Physiology.

recognized by all authorities and is disputed by none. In all of these cases the anatomical perversion is a gross one and the functional change is also gross. Why should we limit the application of the principle to the gross cases? Let us further analyze some of the above instances. All are agreed that the dislocation of a hip can produce an inflammation of the sciatic nerve. Is it a greater tax on the intellect to conceive of a functional disorder of less degree dependent upon a less severe structural perversion?

If an intense stimulus will produce neuritis why will not a less intense but long continued stimulus produce, if not a neuritis, at least an appreciable disorder of some other kind, for instance, a deadening effect, a numbness, or change in vasomotor impulses that are carried by the sciatic nerve? Note the case of the paralysis, partial or complete, dependent on dislocation of a cervical vertebra. Is it an insult to intelligence to assent to the proposition that if a gross dislocation can produce a paralysis, a less perversion, for instance, a severe torsion or strain, may so impinge not upon the cord directly but upon the innumerable channels that connect the contents of the neural canal with the structures anterior to the spinal column, as to very materially interfere with the exchange between these regions?

If it be possible that gangrene of a tissue is dependent on the total obstruction to the arterial supply to that tissue, why is it not reasonable that a partial interference with the flow of blood through an artery may result in a less completely starved condition? That partial interference may easily be produced by direct pressure of structures upon it or by interference with the nerve mechanism which governs its diameter. And if an enlarged lymphatic gland may by pressure produce a rapid action of the heart through interference with the inhibitory function of the vagus, why is it not reasonable that tightened conditions in the spinal structures, by pressure upon the accelerator fibres found in the sympathetic, may produce a similar overactivity of the heart? There is no question that such tightened conditions occur, and are followed by such cardiac disorders.

If the lungs are weakened by a depressed condition of the thorax walls, why is it not true that the heart may suffer from a like crowding, or, through a weakened diaphragm which reasonably could follow the depressed ribs, a general ptosis of the abdominal

organs result? If it is possible that contraction of cervical muscles produces a change in cerebral circulation why may not a chronically contracted muscle produce a chronic disturbance of that circulation and hence a congested headache?

If a pregnant uterus by virtue of its size and weight may produce renal disorder by pressure, why may not a tumor or a subluxated bone, or edematous tissues acting upon a vital structure directly or indirectly connected with the kidney, produce disorder of that organ in a similar manner?

If a sprained ankle is a common occurrence and if congestion and infiltration are resulting conditions which cause direct and reflex disturbances, why is it such a draft upon credulity to believe that a similar common condition of sprain, with similar congestions and infiltrations and similar direct and reflex disorders may occur in the scores of articulations which are presented by the spinal column?

But it is not necessary to rest the case entirely on assumption. Evidence has been accumulated and is still accumulating which is most confirmatory in character. Case after case has been found by physicians who are careful in observation and logical in judgment, showing that these various structural perversions are present and are associated with functional disorders, the removal of the structural conditions uniformly resulting in a disappearance of the disorder. It is at the present time not so much a question as to the fact that a structural disorder produces the disease as to the details of the manner in which the latter is brought about.

(Experiments performed upon animals, especially by members of the staff of the A. T. Still Research Institute, show that the subluxations of vertebrae can be produced, and can be shown in stereoscopic X-ray plates; that these lesions do produce pathological changes in the tissues around the lesions, and that distant tissues, innervated from the corresponding segments, also suffer pathological changes.

Other experiments show that the correction of such lesions results in a more or less complete recovery, according to the amount of tissue destruction produced before the correction of the lesion. Full accounts of these experiments are published in the bulletins of The A. T. Still Research Institute, and in the Journal of the American Osteopathic Association.)

CHAPTER XIV

DISEASE MAINTAINED BY STRUCTURE

It is not of such moment as to what was the original stimulus to a disordered function. We have no quarrel with those who insist that the functional disorder may result from a multitude of forces which act continually upon the organism. It is readily admitted that constant disregard for well known laws of health must of necessity produce disorder, and in another section special attention is called to the fact. The more important question is to determine what is fact and what is fiction in the mass of rules given for correct living. A thousand conditions of environment and of individual habit may initiate or predispose to disorder of function. This fact must be recognized in order that the individual shall understand that he must reap what he sows. It must be a part of the work of the physician, as it is only less emphatically the duty of every man, to assist in a proper understanding of the known laws of health, and a proper appreciation of the responsibility of one's own health, bodily, mental and spiritual. Temperance in all things is absolutely a prerequisite for continued well being. Any intemperance will result in at least a temporary impairment of function. With most normal individuals a few experiences teach wisdom. Hence most individuals pass through life with a fair degree of health so far as disorder dependent on wilful abuse is concerned. When, however, a disorder becomes manifest and persists in spite of removal of the intemperance or abnormal conditions of environment it is certainly logical to assume that some other factor is maintaining the disease. The osteopath insists that the other factor is perversion of structure, and that structure a part which is less immediately and less completely subject to vital control—the more inert tissues such as bone, ligament, cartilage, and other connecting structures. Hence, where a disorder is maintained, reason and observation both indicate that the structural condition is the factor that prevents a return to normal functioning. The question, therefore, is not as to the original force that caused the disorder, but why does not the sick man get well?

It is just as much a normal power of the organism to return

to normal functioning as it is to maintain functional equilibrium manifest in the ordinary healthful life. It is in fact impossible to differentiate between the two. An excess of carbon dioxid is a normal stimulus to the removal of that excess. The organism restores its proper function largely through the medium of stimuli furnished by its own katabolic products. The presence of other substances not nutritive in character, e. g., bacterial products, produces a similar result.

Whether through ages of adaptation and from hereditary transmission or from inherent endowment co-equal with life itself, the fact that this self-protective power exists may be affirmed with little probability of error; and that function is self-regulative while structure is only less responsive to the same forces is equally certain. Hence in the ordinary disorder that seems beyond the limits of self-restoration we must logically look to the structural condition for the factor maintaining the disorder. Experience has shown that little in addition is needed, for with the average individual the average environment constitutes a normal condition. With such an environment to which the individual has long been accustomed the organism is master of the situation and needs only freedom to exercise its restorative powers.

The truth of these considerations is evident in case of chronic disorder. But they are no less true if less evident in acute conditions. It is said that 95 per cent. of acute cases get well whether they are treated or not. This does not argue for a policy of non-interference. For osteopathic experience shows unquestionably that the reparative forces may be given greater freedom for action by appropriate treatment. In general the length of time required by the unaided organism to restore normal conditions may be lessened one-half. What is the philosophy of the treatment under such circumstances? Under the influence of visceral disease reflex muscular contractions lead to disturbed spinal relations, and secondary lesions are produced. This structural perversion is a further cause of functional perversion, and may prevent or delay recovery from the original disease, or may cause other and more chronic diseased conditions, perhaps in other viscera.

Hence by keeping the structural condition normal the total time for recovery is apparently shortened. If this assistance is not given the organism recovers in most cases unaided. But in others the

disease becomes chronic not because the disease itself or the environment or habit of the patient is necessarily an insurmountable hindrance, but because the inert structure which was disturbed has become fixed in its relations.

It is not always necessary to assume that the perverted structure arose as a secondary result. It is enough to note that in many cases there exists a deranged structural condition which, not of itself capable of producing marked disorder, yet causes lessened resistance to extraordinary stimuli, and, when the disease results from the latter, prevents a complete response to the new conditions by interfering with normal nerve or blood action. In such cases the structural difficulty is part of the original cause of the disease in that it represents a predisposition. It becomes the principal if not the entire factor which prevents a ready return to normal.

CHAPTER XV

THE LESION

By osteopathic usage the word lesion has acquired special significance. The surgical conception of lesion, any hurt or injury to a part, and the pathological concept, any local or circumscribed area of tissue undergoing abnormal functional changes, must be carefully distinguished from the osteopathic concept which is any structural perversion which produces or maintains functional disorder. Note first that the definition includes all tissues. While it is true that the bony lesion occupies first place by virtue of history and importance, muscular and ligamentous perversions are rivals of the former for pre-eminence. A viscus may act as a lesion, and among the most serious of diseases are those directly dependent upon pressure from prolapsed viscera. In the second place note that the structure must be perverted, that is, has departed from the usual or average condition. Third, note that the condition of function is included in the conception of lesion. This is of fundamental importance. From what has been said in a previous section it can be understood that a structure may be perverted in the sense of being unusual and still not be a cause for change of function. This variation is still within the limits of normal adaptation. A spine may have its curves markedly exaggerated or completely obliterated and the functional conditions still remain normal. To make of it a lesion in the osteopathic sense there must be included the idea of functional disorder as a consequence of the structural perversion.

The perverted structural condition may be a disturbed positional relation of parts. These may be further classified into (a) dislocation, which usually refers to bony tissue and represents a condition in which there is a complete separation of the articular surfaces. An example of this class would be a hip dislocation. (b) Subluxation, also usually referring to bony structures but in which there is an incomplete separation of the articular surfaces, is a second type. A rib is more commonly subluxated than dislocated. (c) Displacement is more commonly applied to yielding structures and especially viscera in which there are no well marked or special articulating

surfaces. It is more appropriate to speak of a displaced uterus than of a subluxated or dislocated one. (d) The lesion may be in the nature of contraction or contracture, more especially of muscular tissue. While it is true that all living tissue is more or less susceptible to change in shape through the phenomenon of contraction, muscle tissue because of its specially developed power in this particular must occupy first place. While the contraction is a position change it is also a size change and might appropriately be considered in the next division. For there is undoubtedly in the majority of chronic muscular contractures an increase in the total bulk of the muscle though not necessarily in the amount of muscular fiber.

(Studies made of such muscles by Dr. C. P. McConnell and in the laboratories of the A. T. Still Research Institute show that the first changes include edema, hemorrhage per diapedsin, and cloudy swelling. There is diminished alkalinity, and the condition of the muscles resembles that of early rigor mortis. After some months, an increase in the connective tissue elements occurs, many of the muscular fibers atrophy, the muscle shortens, and the condition properly called "contracture" is produced.)

In the second place the disorder may be a disturbed size relation of parts. These may be also further classified into (a) lesions from overgrowth. In the case of a hypertrophied heart or a thoracic aneurism direct pressure is exerted upon the lungs and other thoracic structures with resulting disorder of the function. (b) Arrested growth and (c) atrophy are less common conditions but are occasionally noted. In the case of an atrophied liver the resulting disturbance of associated abdominal viscera may be directly dependent upon the size disturbance. (d) Perverted growths, as in the case of exostoses and tumors which are special forms of overgrowth conditions, are considered as lesions.

The Causes of Lesions

For purposes of convenience the causes of lesions may be classified into external or environmental, and internal. Among the former the most common is mechanical violence such as a blow, a fall, a mechanical shock or jar to the organism produced in whatever way. It will be found on inquiring into the history of a vast number

of cases of disease that the onset of the disorder was noticed soon after having suffered the violence, and owing to this fact it is always the part of wisdom to inquire carefully into the history of the case.

Mechanical

These mechanical causes act alike in producing bony, muscular, ligamentous or visceral lesions. A prolapsed uterus is often found to have its cause in a sudden mechanical jarring of the body. A subluxated rib is a common result of direct pressure from without such as might occur in the strenuous periods of a football game or the less intense but more prolonged compression of certain steel braces constituting a part of the wardrobe of fashionable woman. A sudden attempt to protect one's self from falling accounts for a strained muscle, a sprained articulation, or a subluxated vertebra.

Thermal

Another important external cause is that of temperature change. In order that a thermal condition shall produce its effect on responsive tissue it must be a sudden change and usually a change from a higher to a lower temperature. While experimental physiology indicates the possibility of a contracted muscle dependent on a change from a lower to a higher temperature, little evidence has been produced to show that a similar condition is produced in the normal living human body under those circumstances. Lack of evidence however does not prove that the contraction may not be brought about in the way suggested. With regard to the production of contracted muscles resulting from sudden exposure to cold atmosphere or a cold draught, all osteopaths are agreed in emphatic affirmation. The primary effect in point of time and importance, then, will be the production of a muscular lesion. But remembering the intimate relation existing between muscles and other tissues it is easily understood how a bony or ligamentous lesion may come about as a consequence of a muscular contracture or chronic contraction. A muscle cannot contract without an approximation of the structures to which the muscle is attached. Hence if it be a spinal muscle a vertebral lesion will be produced, or if it attaches to a rib that structure will be depressed or otherwise disturbed.

Internal Causes

Of the internal causes of lesions posture of the body may be mentioned though perhaps with equal propriety it might be classed under external causes. Especially is this operative in the case of children and young people, the most common form of lesion which results being a curvature of the spine. Any cramped or distorted position assumed for long periods at a time will with a fair degree of certainty result in a gradual change of parts. The continual bending over the desk at school is undoubtedly accountable for numerous spinal disorders. Professions and trades which require the assumption of peculiar positions furnish their quota of patients with characteristic lesions. The dorsal inclination of the head in the process of lathing a ceiling, the flexed position in shoveling, and the stooping of the compositor at his case are all illustrations of the point. In all of these there is a uniform force continuously acting in a definite direction, the inevitable result being in the case of yielding human tissue, definite changes in structure.

Nutritional disturbances are internal causes which comprehend a variety of specific conditions such as congestions, and anæmic states, and nerve irritations. These in most cases are further dependent upon an adjacent structure and it becomes necessary to seek for the cause of the congestion. An overworked organ through a resulting hypertrophy of its tissue becomes a lesion. Not only do viscera act as lesions from congestive conditions but a muscle may become contracted through impulses transmitted by reflex pathways from the viscus. In practically every acute case with which the osteopath comes in contact there are found muscle contractions, in part primary to the disease, in part secondary to it. By the known anatomical facts of central association between spinal nerves and visceral nerves, and the known physiological fact of the radiation of impulses from one part of the spinal cord to another, a reasonable explanation is not difficult. Afferent impulses aroused by a disturbed viscus are transmitted to the spinal cord from which efferent impulses, motor or vasomotor, pass to the spinal muscles. That such an explanation is reasonable is further suggested by reference to Head's law relating to sensory nerves. This law suggests an intimate relation between afferent nerves closely connected centrally; and the histology of the spinal cord shows a close structural relationship between sensory and motor centers, while experiments

and clinical evidence prove from a functional standpoint equally close central connection between an afferent visceral nerve and an efferent motor nerve. Congestion or other nutritional disturbances in the muscle tissue do undoubtedly lead to contraction of muscles. (Animal experiments prove that irritation of viscera, such as may be due to visceral disease, cause reflex contractions of the spinal muscles, often such as to cause recognizable spinal lesions. See the Bulletins of the A. T. Still Research Institute.) Experimental investigation in the laboratory shows that weak acids may be efficient stimuli for the contraction, and it is noted that just such a condition is present in venous congestion or in the fatigued muscles. Venous blood, always less alkaline than arterial, becomes appreciably acid under various circumstances of the organism, due to the presence of carbonic or sarcolactic acid, the latter a common product of katabolism. In fatigue of muscle from overwork or other cause we have conditions entirely favorable for the production of the special form of contraction which is well known to the osteopath. Here the excess of katabolic waste including the sarcolactic acid referred to may easily be sufficient to produce the effect. On the other hand anæmic conditions may easily be responsible for abnormal states of the muscle and the cause of the lesion, though this is perhaps a more debatable proposition.

CHAPTER XVI

MAINTENANCE OF THE LESION

Emphasis has been given to the fact that structural perversion is responsible for disordered function; that both external and internal forces may produce the structural change; and that the organism itself is usually able to effect readjustment after the immediate causal factor ceases to operate. Why is the organism not successful in all cases? Why does the lesion persist?

If the physician is careful in his observation he will find that in a large number of cases, especially of an acute nature, there are numerous secondary lesions present more or less continuously throughout the course of the disease; he will further notice that in many of these cases both perverted function and secondary lesion disappear whether treatment be given or not. What causes or forces or conditions are present in those who become normal that are lacking in the numerous cases where the perversion is not thus self-corrected? This question cannot yet be answered unequivocally, but as further observation is made and deeper study given several suggestions offer themselves which serve to explain the difficulty.

In the case of a dislocation in the surgical meaning of that term there is little about which an issue might be raised. For instance, in a dorsum dislocation of the hip the head of the femur lies entirely outside the acetabulum, from which it is separated by a marked ridge of unyielding tissue which is an effective barrier to adjustment. In a complete dislocation of the cervical vertebra there is present a condition thus described by Scudder: "In this unilateral dislocation of the cervical vertebra an articular process slips over the articular process below it and either catches upon the top of the lower articular process or slips down in front of it."[1] Here there is manifestly sufficient change in the mechanical relations of the processes to prevent self-adjustment, irrespective of any muscle tension that may be associated. But the case may be quite different in the ordinary spinal lesion where the condition is not

[1]Scudder: The Treatment of Fractures with Notes Upon a few Common Displacements.

a dislocation but a subluxation, and in many cases almost inappreciable to touch. It is in such lesions as these that the question arises as to what factor or factors prevent a return to normal.

In presenting the suggested explanations it is necessary to divide the cases into two classes, these lesions due to the thermal or other change which initiate muscular contraction as the primary perversion, and those caused by sudden violence which immediately produce definite strain and displacement of practically all the parts comprising the articulation. In the former class, so far as the simple uncomplicated contraction is concerned, that should disappear just as soon as the stimulus (cold for example) is removed, and hence the case will hardly require attention. But experience and abstract theory both indicate that in numerous cases the muscular lesion is not a simple one. As a result of the shortening of the muscle, deeper structures are disarranged which are an added factor to consider in investigating the lesion. For instance, the contraction of the serratus posticus inferior produces a depression of the lower four ribs. This in turn disturbs the articular structures in connection with the transverse processes and bodies of the vertebræ. These include the entire connective tissue structures, not merely the synovial membranes and the specialized ligamentous tissue. In this case if the original stimulus to contraction is immediately removed, the muscle relaxes and no harm results. But if that original stimulus be not removed, or, what is more likely, the disturbance of the deeper structures causes impairment of the muscle's blood and nerve control, the contraction persists so long as the deeper structural disorder persists. But note that this deeper condition is not likely to remain merely as a tensed or strained articulation. Tension and strain produce irritation, irritation results in congestion, congestion is associated with edema and a large number of abnormal local conditions. When the case has reached this stage essentially the same factors are presented as are considered in the second class of cases referred to above, these lesions due to a definite and abrupt traumatism, as in the case of a fall, blow, or strain. Hence the further course of the two classes are identical.

What occurs when a joint is sprained? DaCosta thus describes the morbid state: "In a bad sprain ligaments are torn; the synovial membrane is contused or crushed; cartilages are loosened or separated; hemorrhage takes place into and about the joint; muscles

and tendons are stretched, displaced or lacerated; vessels and nerves are damaged; the skin is often contused; and portions of the bone or cartilage may be detached from their proper habitat, though still adhering to a ligament or tendon."[1] Note that following the accident, unless motion be produced at rather frequent intervals a stiff joint is the result. What is the occasion for this rigidity? Adhesions and thickenings of the joint structures are undoubtedly responsible. Adhesions usually begin while the inflammatory state is still active, which is also true of overgrowth conditions. Hence this complication of the original displacement is present almost from the beginning. There can be little question that such a state of affairs exists in numberless spinal lesions. For in connection with the spine are scores of articulations, each of which is continually subject to the identical twists and wrenches that produce the striking effects in case of the sprained ankle. The less noticeable character of these sprains is sufficiently explained by the comparatively small size of any individual articulation. In the case of a sprained spine, a lesion due to sudden force, the factor that prevents correct readjustment is certainly not simple muscle contraction; it is principally due to definite change in position, size and smoothness of the more intimate articulating structures, these changes in turn dependent upon congestive and edematous processes resulting from the initial strain.

Is it true of the condition inaugurated by simple muscular contraction? If the latter produces sufficient tension of the deep tissues, there is no question that it is true, though perhaps not so marked in degree. If the muscle contraction is sufficient to seriously disturb the relative position of the articular structures, it is also sufficient to set up the series of changes suggested above. If the condition were due only to the difference in muscular tension then we are justified in the massage of muscles so often employed by not a few practitioners. As a matter of fact the masseur occasionally produces favorable results. He does it in those comparatively few cases where muscle contraction is the sole factor, or where his work is sufficiently deep to effect a real adjustment.

Essentially then, the proposition reduces to one to which reference must continually be made, namely that muscle tissue is self-adjustive, and so soon as the stimulus to contraction is removed

[1]DaCosta: Modern Surgery.

there is little if any necessity for direct relaxing measures. The deeper tissues—bone, cartilage and other connective tissues which are less capable of self-adjustment—are the structures which by virtue of their size, irregularities, and roughened surfaces, immediately prevent a return to the normal. They may impair the vascular or nervous state of other tissues, including muscle, and these may be irregularly tensed and thus help in maintaining the lesion.

In conclusion it will be noted that in all likelihood no single factor maintains the lesion. Just as practically every spinal lesion involves bone, ligament, and muscle, so the persistent nature of the lesion is due to more than one factor.

CHAPTER XVII

MEDIA THROUGH WHICH LESIONS PRODUCE DISEASE

1. Direct pressure may cause the organ to be involved in disease. A rib or ribs may be depressed thereby pressing directly upon the lungs, or preventing their normal expansion, resulting in immediate disorder or a lessened resistance to specific infection. A floating kidney may press directly upon the bowels thereby inducing constipation or other trouble. The pyriformis muscle or others closely associated may in contraction impinge directly upon the sciatic nerve causing a neuritis.

2. Pressure upon the artery which supplies it causes an anæmic condition of the organ and a possible secondary hyperæmia of some closely associated part. By virtue of a torsion of the cervical vertebra with a consequent tightening and thickening of the intervertebral ligaments, the blood flow through the intervertebral artery is hindered and the spinal cord suffers. An approximated condition of the upper ribs impairs the arterial supply to the mammary gland and the secretion of milk is hindered. An abdominal tumor or a pregnant uterus impinges on the renal arteries and kidney trouble is experienced.

3. Pressure upon the vein which drains it causes a hyperæmia of the organ with a possible secondary anæmia of closely associated structures. A depressed sternum and anterior ends of clavicle and first rib through pressure upon the inferior thyroid is one cause of goitre. A tightened muscular and ligamentous condition about the saphenous opening may cause varicose veins. Muscular contraction in the cervical region interferes with the drainage of the cephalic structures and headache results. In cirrhosis of the liver an obstruction to the portal system occurs with a resulting abdominal dropsy and a secondary anæmia of other parts of the body.

4. The organ may be disordered by pressure upon the lymph channels with which it is associated, thereby producing innumerable disordered conditions through the interference with nutritive and sewerage functions, and by a secondary process materially affecting the general vascular system.

5. Pressure upon a nerve directly or reflexly connected with it causes disorder of the organ. The heart may be interfered with by tightened ligaments or edementous areas causing pressure upon the cardiac accelerators which issue from the spinal cord from the first to the fourth thoracic segments. It may be involved in disorder by a disturbed uterine condition, in which case it is a reflex effect. Or the accelerators may carry too many or too rapid impulses to the heart dependent on contracted spinal muscles in the upper thoracic area, this being also a case of disturbance dependent upon reflex action. Note the physiological law that the total activity of a segment of the spinal cord varies directly with the algebraic sum of impulses passing to it. Note the extreme number and variety of effects possible from nerve disturbance. A sensory impingement usually produces pain, direct or referred to other fields. Every sensory nerve is a possible pathway for impulses setting in motion a vasomotor change; hence anæmic or hyperæmic conditions may result. These impulses may also initiate excessive activity of the sweat glands and hence perspiration becomes abnormal. The nerve may carry the impulse which inaugurates the change in any efferent channel and hence motion may be increased or decreased, secretion accelerated or depressed, inhibition modified, trophicity lessened. All of these effects are dependent on interference with afferent or sensory nerves. On the other hand the efferent channels themselves are equally subject to interruption, while any change in the nutritive condition of a segment of the spinal cord or a center in the brain affects to a greater or less degree all nerve pathways in direct or reflex connection with them. The medium of nerve interference is without doubt the most important with which we deal.

Through these several media we may explain with greater or less satisfaction the varied results that have been observed to follow a lesion. The difficulty lies in determining in each individual case which of the several explanations is the true one—a difficulty at once apparent and in many cases insurmountable. It must be noted that a lesion sufficient to produce impingement on one of the channels is sufficient to affect another, so that in most cases we will have more than one of the channels interrupted and hence the greater possibility of extreme effects.

CHAPTER XVIII

VARYING EFFECTS OF LESIONS

The extent of the lesion bears no constant relation to the intensity or extent of the effect. Note the case of the hunch-back whose lesion condition is quite apparent and great in extent. Yet in many cases his health is not markedly impaired. On the other hand a slight strain at the articulation between the eleventh and twelfth thoracic vertebrae has resulted in immediate nephritis of a very serious nature. The strain was barely noticeable on palpation or inspection, yet the effect was far reaching. Several facts suggest an explanation of the condition. The effect varies directly with the functional activity of the tissue interfered with. If a lesion brings pressure upon simple connective tissue little result may be looked for. The connective tissue is comparatively inert. If the pressure be upon nerve tissue the result is far-reaching. Nerve tissue is most active. It is developed with the special end in view of furnishing a material quick to respond to stimuli and capable of conducting the impulse to other parts of the body. Hence a lesser intensity of stimulus from pressure will be necessary to cause response than in connective tissue and a much more rapid transmission of the impulse will also result. A muscle impinged upon, less active than nerve in respect to readiness of response and speed of propagation, is associated with less immediate effect. An artery involved is more likely to result in disorder than is some other structure because of a wider influence and a more ready response to pressure.

Adaptation

Again the adjustment possibilities of the structure involved in lesion are important factors in modifying the response, and this is in turn largely dependent on the abruptness and strength of the stimulus, i. e., the pressure from the lesion. A lesion produced gradually, as is true in most cases of curvature of the spine, does not constitute a change sufficient to be effective as a stimulus. Note that it is an abrupt change of pressures that constitutes a mechanical stimulus. In the case, then, of the posterior curvature—the extreme kyphosis—the pressure has been so gradually applied that

the structures in contact were not stimulated but were able to adapt themselves to the gradually changing conditions. It is a recognized rule in physiology that a change sufficient to produce a response in a tissue if continuously applied will later fail to produce such response. The tissue has adapted itself to the stimulus and is not further affected thereby. In the case of the sudden wrench of an articulation causing nephritis the change in pressures was so intense and so abrupt as to constitute a very efficient stimulus so that the extreme result was brought about. It must be noted however that ultimately further adjustment will be impossible and the tissue must respond. Note that finally the hunch-back succumbs to conditions much less severe than would be the case if the spine were normal. The summation of stimuli may help in the explanation of such conditions. A stimulus ineffective at first, by repeated operation may cause such an accumulation of effect as to result in a discharge. The evil effects of the abnormal spinal condition, gradually and constantly active, lower the resistance of the entire body and finally produce a summation of evils with resulting disaster.

Varying Symptoms

2. Another important fact that must be noted is that the region of apparent disturbance is not necessarily or usually the seat of the lesion. While this statement applies with more force to the subjective disturbance of pain yet it is noted in others not subjective. With respect to pain, it is sufficient to refer to a later chapter in which is discussed the condition of transferred pain. At present note that the pain caused by an irritation may be felt in any part of the distribution or course of the nerve irritated. In pressure at the elbow upon the ulna pain is not only felt at that point of pressure but also in many cases most markedly in the fingers, i. e., where the nerves are specially developed for receiving stimuli. A lesion in the spine by pressure on fibers forming the intercostals may produce pain felt over the anterior surface of the chest or abdomen. Hilton's rule that pain felt superficially and not accompanied by a local rise in temperature indicates a spinal origin of the pain, is interesting and helpful, especially to osteopaths. Especially is this likely to be the origin if the pain be symmetrical, i. e., on both sides of the median line at corresponding

points. An associated local rise in temperature together with other evidences of local inflammation indicates the latter as the probable immediate irritant.

Reflex Effects

But the application can be made to no other than pain conditions. Note that a pelvic lesion primarily affecting the uterus may cause symptoms only with the heart, palpitation of that organ being a quite common result. In this case the patient and physician would naturally assume that the heart was primarily at fault. But experience suggests that it is otherwise, the heart being affected through the complicated mechanism of reflex activity. The impulses from a disturbed uterus are carried by the sensory nerves to the centers in the spinal cord, and the abnormal action of these centers affects other spinal centers. Impulses from these disturbed centers pass by way of the gray rami fibers and the sympathetic ganglia to the heart or other viscera. But why should the heart be thus involved and not some other organ? In answer it may be said that in other cases and at times in the same case it is another organ. Byron Robinson's suggestion that it is dependent on a condition analogous to an electric arrangement is suggestive but unsatisfactory in that there are too many exceptions. His suggestion is that that organ will be involved reflexly which is connected to the primary organ by the greatest number of nerve strands. Unfortunately he does not show that such is the case. Personally the author prefers another explanation in which there are noticed few exceptions and those perhaps only apparent. Under the circumstances of a perfectly normal condition of every other organ of the body, little disturbance if any results when one is affected. But in most cases some one or more organs are in an irritable state. In such a case a nerve impulse coming from the organ primarily involved is an effective cause of perverted function in the irritable organ. Hence the statement may be made after this manner: that organ will be involved reflexly which is in the more irritable condition. The excess of irritability in one organ over that in another depends to a slight extent only upon inherent capacity, and in much greater part upon a disturbed nutrition dependent on an associated lesion. In case of a reflex disorder, then, we must look for an additional cause in the way of predisposition. In the majority of cases exper-

ience shows that the predisposition results from a lesion in the region of the source of nutrition for the organ. Hence in case of the palpitation resulting from uterine disorder a lesion should be found in the region of innervation of the heart, or in those structures which may directly affect the heart. And such is the case. The reflex impulse is but the exciting cause, the lesion the predisposing; neither alone being sufficient to destroy the cardiac equilibrium but acting conjointly they are able so to do.

It is a question whether a large number of so called reflex disorders should be considered reflex except in the manner suggested above. The occipital headache from uterine displacement is much more likely to occur if there be a local lesion deranging the cephalic circulation; the headache resulting from gastric disorder usually presents cervical lesions sufficient to cause the disturbance to appear; even the vomiting of pregnancy is often in direct proportion to the abnormal previous condition of the stomach. Hence, let none rest content with the diagnosis of a "reflex effect." Prove that the local structural conditions are normal before sentencing the reflex mechanism as the sole cause for the disturbance.

CHAPTER XIX

ABUSE OF FUNCTION

Osteopaths make no claim that there are no possible disease conditions from other than structural perversions. Any one will recognize the fact that by abuse of any organ or its function abnormal action may result. Indeed every life is a continued fluctuation between a normal and an abnormal condition, so that it becomes evident that disease is but a relative term. If a continued excess of carbon dioxid in the blood constitutes a disease, shall we decide that the amount necessary to arouse increased respiratory activity is a disease? That condition continues for an appreciable length of time and in so far as it does it is a normal stimulus to the respiratory activity, it is not to be considered disease. The organism is able to adjust its functioning immediately. What is true in the case of respiration is true of the body as a whole. The struggle between organism and environment is a ceaseless one in which the organism is usually triumphant, but there are times when abnormal factors in the environment temporarily gain the supremacy. In these cases enough of a departure from normal is apparent to be dignified by the term disease. It is this condition that is present in abuse of an organ or its function. Excess of food, overwork of muscle, contaminated air, all represent what is foreign to the organism, and as such stimulates it to an unusual response. In the vast majority of cases the organism is victor though no external aid is given. At least 95 per cent. of acute cases are overcome without treatment of any kind. In such cases the full responsive power is usually exerted in the attempt to overcome. If the stimulus is too intense or prolonged, death results. The duty of the physician in such cases is to secure and maintain such a condition of organism and environment as allows the fullest freedom to the responsive power of the organism. Of prime importance in this connection is the prevention and overcoming of secondary lesions. This with additional attention to known laws of hygiene and sanitation usually suffice to enable a return to the usual grade of organic action.

Time Relations

The abuse that causes disease may be overuse in time relations. That is, the organ functioning through too great a proportion of

the allotted time to allow for repair will ultimately be disturbed. This disturbance may be in the nature of a hypertrophy. An overused muscle will become enlarged, as in case of the heart after valvular disorder. The liver in an individual who constantly overeats will ultimately be somewhat increased in size. The constant abuse of the stomach may result in a thickening mucosa. In many of these cases the hypertrophy is in part physiological; for instance the hypertrophied heart is a necessity under the existing circumstances, i. e., the inefficient valve. At the same time it is secured at the expense of a continuous tendency toward the production of disorder in neighboring structures, for instance impaired respiration dependent on lung pressure from the enlarged heart.

Secondly, exhaustion is a common result from abuse in point of time. In the case of the enlarged heart, so long as compensation is maintained little difficulty may be experienced, but usually the time comes when all reserve forces have been drawn upon, the heart is no longer able to increase its substance to meet the increased demands, and exhaustion of its energy and substance rapidly follows. The gastric glands, continually called upon to do excessive work, finally yield to the inevitable and fail to supply the requisite amount of digestive fluids. In any of these cases a third condition is likely to result, that of atrophy. In this connection note the wasting of heart muscle during the period of broken compensation, the thinning and waste of substance in the walls of the stomach, or the final condition of atrophy and degeneration in an overworked liver.

Intensity

Again the abuse may be overuse in intensity. Apoplexy resulting from sudden increase in blood pressure from overexercise of body or mind is a case in point. Aneurism is similarly caused. Excessive lifting, athletic efforts and the like, may produce strains and ruptures in various of the body tissues. This is not limited to those cases where a pre-existing weakness makes the sudden strain effective, as, for instance, the usual arterio-sclerosis in those individuals subject to apoplectic attacks; but where the strain itself is the primary and perhaps the sole causal factor. It is immaterial whether the predisposition exists; the strain is an abuse under any circumstances.

Diminished Functions

Instead of overuse constituting the abuse, under use may result

in a disorder. It is a well known fact that a muscle kept inactive for a considerable period will gradually waste away. This is not true of muscle only. It seems to be a fundamental biological law that the structure unused becomes incapable of use, and if certain theories of evolution be accepted we may explain the gradual disappearance of structures in man and other animals on the basis of disuse. Note in the case of the lungs of an individual who contracts "lazy habits of breathing," that they are much more susceptible to disorders than are those of him who breathes naturally and deeply. The apices are the regions of lung tissue most commonly involved in tuberculosis and they are involved first in point of time. The apex is the least exercised of all parts. The two facts may be closely associated. Again, proteid food substances furnish a most efficient stimulus to the secretion of pepsin by the gastric glands. The consumption of predigested, peptonized foods may constitute a definite abuse though furnishing lessened exercise of the peptic glands with a consequent atrophy of these structures.

Perversions

Finally reference may be made to abuse in the form of perverted use of function. The teeth are structures designed to grind the food materials. If that function is given to the stomach through improper mastication, there is a perverted use of the stomach. Life in an environment of impure air, noxious vapors, and dust particles constitutes an abuse of the respiratory function. According to the report of witnesses in the recent coal strike investigation one of the causes of the shortened life period of the coal miner is the continued inhalation of coal dust. Post-mortems of those who have worked for long periods in an atmosphere charged with metal or other particles show the induration of the lungs from deposit of the material as a factor in the cause of death. Mouth breathing is a perversion and is accountable for occasional disorders of the respiratory, or upper part of the digestive channel. The introduction into the body through any pathway, of a material foreign to the organism constitutes a perversion. Hence, drugs taken into the alimentary canal, pathogenic bacteria with their toxins, and all other forms of poisoning constitute abuse conditions in the nature of perverted use. In a large number of such cases the cause is of an exciting character, a predisposition being present which impairs the responsive power of the organism. This is especially true of micro-organisms, a discussion of which is given in a further chapter.

CHAPTER XX

PREDISPOSING AND EXCITING CAUSES OF DISEASE

The causes of disease may further be classified in accordance with their relative capacity to produce disorder without the aid of any other factors, predisposing and exciting. This classification is not an absolute one but may be used with advantage for purposes of convenience and better understanding. A predisposing cause is any condition of the organism or its environment which, while not producing sufficient disorder to constitute disease, renders the organism more susceptible to other causes. As illustrations of such may be mentioned the following; In hay fever two conditions seem to be essential in the production of the characteristic symptom, an irritable condition of the nasal mucosa and a specific irritant, as pollen from certain plants, dust particles and the like. The weakness is more or less continuously present, the specific irritant only at special periods. In this case the irritable mucosa with whatever has caused that condition, as a lesion in the cervical region, constitutes the predisposing cause, the pollen or dust particles representing the exciting cause. Neither of these two is capable alone of producing the attack but acting conjointly are sufficient. The small boy is noted for his craving for green apples. If a lesion be present in his splanchnic region and he indulges the craving only moderately, an attack of cholera morbus is the result. In this case the green apple represents the final aggravation added to a stomach already weakened from vasomotor disturbance maintained by the splanchnic lesion. A depressed thoracic region, by limiting the amplitude of the respiratory movements, renders the lungs less able to resist tuberculosis infection, the tubercle bacillus acting as the immediate cause of pulmonary consumption, the former the predisposition to the disorder. Rigidity of the lower thoracic area of the spinal column diminishes resistance to infection, and correction of this lesion increases immunity.[1] Pulmonary troubles tend to run in families. It is not the inheritance of the specific condition but the peculiarity of structure. Most reflex disorders are satisfactorily explained from this double cause standpoint. For instance, a com-

[1]C. A. Whiting: Opsonic Index as Affected by Mechanical Stimulation, and other reports.

mon accompaniment of uterine disorder is palpitation of the heart. Such a disturbed heart rate is much more likely in an individual with a spinal lesion in the cardiac area than in one whose heart control is not interfered with.

Age, sex, temperament, and race, relating to the organism; and climate, season, atmospheric and other environmental circumstances may constitute predisposing causes or occasions. It is common knowledge that children are more susceptible than adults to measles or scarlet fever, while arterio-sclerosis, paralysis agitans, and numerous other disorders affect only the adult or aged. The peculiar condition of the organism at these different periods constitutes a predisposition. The negro race is more susceptible to tuberculosis and less to yellow fever and malaria than is the Caucasian; and this by virtue of some inherent difference in the organism which is without satisfactory explanation. Climate is accountable for special disorders. Catarrhal affections of the respiratory tract are common in cold, damp, and changeable localities, while typhoid and other fever conditions are associated with late summer and autumn, in each case predisposing to the onset of the disease through the agency of various exciting stimuli.

A point to be noted in this connection is the fact of what may be conveniently spoken of as a reversibility of causes. That is, a lesion which in one set of circumstances constitutes a predisposition, may in another be an excitant. Note the case in hay fever. An individual manifests a lesion in the cervical region but no symptoms, until the season when pollen is plentiful, when the attack is initiated. In this case the lesion is predisposing, the pollen exciting, to the disorder. Another individual continuously living in a pollen-laden atmosphere is unaffected thereby. But a lesion is produced, when the attack at once supervenes. Thus predisposition and excitant have been reversed. Climate conditions may be the excitant or a predisposing cause. In the first case a lesion is present rendering the nasal tissues susceptible to the influence of sudden changes of temperature, the latter being the excitant of the disorder; on the other hand an individual living in a changeable climate is predisposed to catarrhal disorders by virtue of the environment, the catarrhal condition itself being excited on the production of a specific lesion. An individual with a normal splanchnic region may continually abuse his stomach by overeating and still no gastric

disturbance result, but on the production of a lesion disorder soon becomes manifest; on the other hand an individual with a lesion in his splanchnic region may show no marked evidence of stomach trouble but on abuse of his stomach by dietetic errors disease occurs.

It is to be noted further that while a predisposing cause of disease usually is not sufficient to produce the disease, an excitement may produce it with or without the addition of the other factor. While it is much more likely that disease will result from the eating of green apples in the case of a child who shows specific splanchnic lesion, experience would indicate that the green apples alone are sometimes an efficient cause.

Finally it is to be noted that in a large number of disease conditions of any permanency in time they are dependent not on a single cause but upon numerous factors in which numerous lesions and numerous forms of abuse may be concerned in the various relations of predisposition, predisposing occasions, and exciting causes.[1]

[1]For excellent discussion of "Summation of Causes in Disease and Death" by E. R. Booth, Ph. D., D. O., see October, 1902, issue of Journal of the American Osteopathic Association.

CHAPTER XXI

THE GERM THEORY OF DISEASE

It seems proper at this time to discuss a problem in relation to disease which has in recent years assumed extreme importance. The germ theory of disease is not at all a new explanation of disease conditions, for ever since the invention of the compound microscope in the middle of the seventeenth century the fact that small forms of life were associated with certain diseases has been known; and not only was this association known but shortly following the discovery of micro-organisms the doctrine of a causal relation between such micro-organisms and the disease was promulgated, and, as suggested by Abbot, amounted almost to a germ-mania. But like numerous other facts and theories based upon those facts this was practically lost sight of until late in the nineteenth century when it was again revived by numerous investigators of world renown, among whom the names of Pasteur, Klebs and Koch stand pre-eminent. These, with others, placed the theory upon fairly sure ground in showing by methods to which no objections could be raised that in certain cases there is such a definite relation between the pathological condition and the presence of the micro-organism. The question is not yet entirely settled as to the nature of that relation. Is the disease as it exists responsible for the presence of the micro-organism, or do the bacteria produce the pathological condition? In accordance with these two ideas the micro-organisms have been classified into the Saprophytic, or those which live only upon non-living matter; and Pathogenic, or those which by virtue of some deleterious action definitely produce the disease condition. Doctor Still has insisted that all are of the former class and compares them to buzzards whose function in the larger world is to render dead and decaying material incapable of further harm. This view is further supported by the fact that certain bacteria, usually saprophytic, become pathogenic under certain circumstances. For example, the colon bacillus is usually harmless, yet when associated with the typhoid bacillus, or when other inflammatory conditions are present, this same colon bacillus becomes actively path-

ogenic. The ameba coli also seems almost or quite harmless, yet when it is associated with other causes of intestinal disease, becomes definitely pathogenic.

The question arises as to the manner in which bacteria act to cause disease in those individuals susceptible to invasion. The effects of bacterial action may be either local or constitutional, or, usually, both.

Local Effects

Local effects may be either mechanical or histological, or both.

"Sometimes masses of micro-organisms more or less completely occlude small blood-vessels and occasion secondary changes in the tissues in this mechanical way. In other cases the obstruction is incomplete, but occasions thrombosis in the blood-vessels and areas of necrosis in the region thus deprived of blood; hemorrhagic extravasations of blood are not uncommon in such cases."

"The histological changes occasioned by bacteria are proliferative and destructive, among the latter being various degenerations and necroses."

" It would seem from late observations that the exact reaction following the primary settling of an infecting microbe depends upon whether it is able, by toxin formation, to destroy normal oxidative processes, in which case necrosis is apt to occur, or to act primarily with positive chemotactic power, in which case local suppuration usually appears."[1]

Constitutional Effects

The constitutional effects of bacterial invasion depend upon the production of poisonous substances, usually by the bacteria, but sometimes by the tissues injured by the bacteria. These include several types.

Ptomaines are produced by the decomposition of the media in which the bacteria grow. They are not specific, and they do not produce antitoxins. Their chemical structures are known.

Exotoxins are soluble and diffusible poisonous substances produced by bacterial activities. They are specific, do produce antitoxins, and their chemical structure has not yet been determined.

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[1] Stengel and Fox, Textbook of Pathology, 1921.

Endotoxins develop within the bodies of bacteria, and do not injure the body of the host until the bacteria die, when the degeneration of their bodies sets the endotoxins free. They do not produce antitoxins, as a rule; their chemical structure is not known.

Bacterial proteins seem to make up the entire body of certain bacteria. They may be definitely toxic. Little is known of them.

Immunity

A few suggestions regarding the nature of immunity may not be out of place. It may be natural or acquired. Neither of these is to be considered absolute, and immunity may be broken by any one of many abnormal conditions.

The skin and mucous membranes of the body give structural immunity. The hydrochloric acid of the gastric juice, the alkaline and proteolytic secretions of the intestinal juices illustrate the immunity due to secretions. The flow of secretions toward the surface of the body is a factor in immunity. The increased exudation of fluids, as in coryza and enteritis, illustrate a reaction which increases natural immunity. Species immunity is found abundantly, and this applies to the host as well as to the invader. One type of tuberculosis is found in fish, but cannot be given to any mammal except the rabbit: nor can fish be affected by human tuberculosis. Man is susceptible to trypanosoma gambiense, but not to trypanosome naganae.

Species immunity can be broken in many cases. Fowls are immune to anthrax, under normal conditions, but fowls kept at low temperatures by Pasteur became susceptible to anthrax. Frogs are not susceptible to anthrax, under their normal conditions, but when their temperature is raised to 35° they also become susceptible to anthrax. It is evident that it is not the infectious agent that is modified, but the resistance of the fowl and the frog, by temperatures abnormal to them.

Racial immunity probably exists, but it is less important than is commonly supposed. Many facts supposed to indicate racial immunity are not such, but certain races seem to be exempt because of good sanitation, or because children suffer from light and immunizing attacks of the disease, or because severe attacks kill off susceptible individuals in childhood. Even after due allowance has been

made for these, and other related facts, there still seems some basis for a belief in racial immunity. In animals racial differences in immunity are often found. The culex mosquito rarely harbors malarial parasites. Gray rats are more resistant to streptococcus than white rats; field mice are susceptible to glanders, while white mice are immune. Instances might be multiplied indefinitely, which illustrate the peculiarities of immune reactions, and which show how immunity may be broken by various abnormal states of the individuals subjected to infectious agents.

Individual immunity is often noted. Even during great epidemics a comparatively small proportion of people succumb to infection. The great number of "carriers" illustrates the fact that not only the infectious agent, but also a receptive and susceptible host must be present if infectious disease is to occur.

Inherited immunity may be noted in family and in racial immunity. Congenital immunity is that due to intrauterine infection, in which the foetus suffers the disease, or it may be due to a transference of maternal immunity.

Acquired immunity is due to previous infection, and to any one of many methods of conferring immunity without having suffered from the disease in a serious form. Immunity may be conferred by a light attack of the disease; by voluntary infection with an attenuated virus; by infection with dead bacteria; by the use of the bacterial products. Immunity may be produced to certain poisons produced by animal life, as snake venom, and by vegetables, as ricin, abrin, crotin, and other poisons. Not all poisons produce neutralizing anti-bodies, but a number of the more virulent have been found to do so.

Passive immunity may be secured through the use of other animals. The horse, for example, produces antitoxin, which is much used in the treatment of diphtheria. Passive immunity carries with it certain dangers, and is only safe in the hands of experienced and efficient physicians. The dangers include poisoning, other infections, anaphylaxis, and other serious conditions, except when the method is employed with accuracy and skill. Even then, the method can only be said to be less harmful than are methods previously employed by medical physicians.

After considering these facts, it is evident that the micro-organism is not the sole cause of any disease. It must find its hospitable

abiding place, and must be allowed to remain unmolested there; a condition not often possible in the normal human body. Note the significance of the following statement: "Under careful precautions against which no objections could be raised the experiments of Billroth and Tiegel were repeated by Pasteur, Burdon-Sanderson, and Klebs, but with the failure in every instance to demonstrate the presence of bacteria in the healthy, living tissue."[1] In a few instances, bacteria seem able to invade bodies of people who seem to be healthy. The gonococcus finds lodgment upon mucous membrane, lives there, and ultimately sets up destructive inflammations, invades the injured tissues, and produces characteristic symptoms. It must be noted that such invasions begin with lodgment and destruction of the neighboring cells; the gonococcus does not actually invade the membrane until that membrane has been injured. Other apparent exceptions can be found, but the statement is substantially accurate, that bacteria do not produce disease, and do not exist, within healthy tissues.

Why are they not present within healthy, living tissue? We believe the only answer possible is that absolutely healthy tissue is incompatable with the propagation of the bacterium. Nancrede emphasizes this fact when he says, "Such healing is only possible in the absence of infection, mark you, not the absence of germs, because as we shall learn, microbes may be present, but unable to multiply and interfere with the normal processes for reasons which will be studied later."[2] The following facts are also significant; in any epidemic of diphtheria there is little difficulty in demonstrating the presence, in the pharyngeal mucous membrane of normal individuals, of the Klebs-Loeffler bacillus; the micrococcus lanceolatus is present in the sputum or in the saliva of many individuals not affected with pneumonia; even in epidemics of Cholera Asiatica unaffected individuals may show the presence of the comma bacillus of Koch in the mucus of the intestinal canal. Why are not these affected? Why is not every individual stricken with the disease during an epidemic? The only possible answer is that they are immune and immunity proves nothing less than that the bacterium cannot be a sufficient cause of disorder.

"The disease-producing character of bacteria, their virulence,

[1]Abbot: Principles of Bacteriology.
[2]Nancrede: Principles of Surgery.

depends upon several factors, which are subject to modifications. Virulence does not depend entirely upon the characteristics of the infectious agent, because the production of disease is an exhibition of reaction between invading organism and host. We may, therefore, say that virulence depends upon two groups of factors, those inherent in the invading organism and those dependent upon the resistance exhibited by the attacked individual."

"The studies of pathogenic bacteria have shown that they acquire or in certain instances may lose virulence by passage through animals, and that they may lose virulence by cultivation upon artificial media." They may acquire increased virulence by cultivation upon artificial media to which animal tissues or extracts have been added, and this increased virulence may be specific for certain types of animals alone.[1]

[1]Karsner and Ecker: Principles of Immunity, 1921.

CHAPTER XXII

METHODS OF PROTECTION AGAINST BACTERIA

The methods by which the body protects itself against bacterial invasion may be briefly considered. The first is phagocytic action, as suggested by Sternberg and later established by Metchnikoff. This consists in the action of the neutrophiles and eosinophiles of the blood; the endothelial cells, which may also be found in the blood at times; and the pulp cells of the spleen and lymph nodes. Connective tissue cells, including bone cells, striated muscle cells and giant cells may at times be vigorously phagocytic.

"The process of phagocytosis involves three steps, first the approach of the cell and the material to be taken up; second the ingestion of the material, and third, the destruction of such material as may be dissolved by the digestive fluids of the cell." (Karsner and Ecker.) The approach is due to chemotaxis, and this may be exemplified in drops of mercury, etc., under various chemical and physical conditions. The ingestion of the foreign body by the cell is secured by the protrusion of pseudopodia by the cell, and these pseudopodia encircle the object, meet, fuse and surround it; the cell protoplasm flows around and over the body, and thus encloses it completely. This phase also is easily reduplicated in non-living materials.

Digestion of the foreign body, if it is digestible, is accomplished by means of secretions from the protoplasm of the cell. This fluid is usually slightly more acid than the cell protoplasm, and it contains proteolytic enzymes, which have, in certain cases, been isolated from digesting cells. If indigestible materials have been ingested, they may remain indefinitely; or may be extruded, or may cause the death of the cell.

Phagocytosis is facilitated by opsonins. These bodies are present in normal blood plasma, and they are greatly increased during bacterial invasion. They are specific for each organism, and sometimes for any one strain of an organism.

Leucocytes produce also substances which destroy bacteria. Extracts made from blood and exudates are definitely bactericidal and

are often specific for the bacteria causing the exudate or the leucocytosis. A leucocytic antibody has been described. Several different enzymes may be extracted from leucocytes which destroy dead bacteria, but are not bactericidal.

The lymphocytes which surround injured or invaded areas produce enzymes; their action is not well understood. Their lipase may be very important in the digestion of the fatty capsule of the tubercle bacillus. They seem also to form a part of the cancer-protective mechanism of the body.

Blood platelets often surround bacteria, and this may interfere with their destructive action.

Local inflammatory changes are often efficient guards against further infection. The increased temperature aids in phagocytosis; the accumulation of leucocytes and lymphocytes produces enzymes and various destructive agents for the bacteria; the connective tissue increase and the deposit of fibrin tend to wall off the diseased areas and prevent the spread of infection.

Antitoxins and antibodies are produced quickly when active infection occurs. Antibodies are produced to some extent in the locality invaded. The lymphatic nodes, the spleen, the liver and the bone marrow seem to be the most important organs for the manufacture of anti-bodies.

The mechanism of recovery from diseases associated with bacterial invasion is of interest. Many experiments have been performed which show beyond question, from whatever aspect the tests are considered, that bodies which are the more nearly structurally correct, make the most speedy and complete recovery; and that anything which disturbs the structure of the body, or which interferes with its functional integrity, interferes also with recovery.

Normal circulation of normal blood seems, after all facts have been considered, to be the most important factor in promoting recovery.

In general, then, we arrive at the conclusion to which the old school physicians must come and in goodly number are already coming, that first, assuming that certain micro-organisms in sufficient number may initiate disorder and may be able to gain access to the body substance, vitiated tissue is almost always a necessary prerequisite before the bacterium can excite the specific disorder,

and that second, the treatment must include methods to overcome the cause of the vitiated tissue—which is usually a lesion or abuse —and to assist the organism in keeping up its strength to overcome the bacterium or its products which constitute the exciting cause. The usual methods for the destruction of bacteria known to be potentially pathogenic, and the usual sanitary provisions, are, of course, employed in all cases of infection.

It would seem therefore that the anathemas hurled at the germ theory advocates by certain osteopaths are entirely uncalled for. The position of osteopathy is impregnable regardless of the ultimate demonstration of the exact relation between bacteria and disease. If it be shown that all such micro-organisms are simply associated and not causal factors, well and good. If the causal relation be established, it is no more true of them than of numerous other elements of environment, that they may promote disease. Continued life in an atmosphere of dust certainly will cause disorder through abuse of the organs of respiration. An environment of excessive microscopic life constitutes an abusing factor in the same way. The organism will be successful, so far as success is at all possible, as long as the machinery through which life manifests itself is kept in its structural integrity, and so long as the environment and abuse conditions do not exceed the limits of normal adaption.

CHAPTER XXIII

THE DIAGNOSIS OF DISEASE

The Symptom

Diagnosis consists in the determination of the location and nature of disturbed conditions. The osteopath recognizes the value of symptoms in that diagnosis. A symptom or a group of symptoms does not constitute disease but is only the evidence that disease exists. To treat the symptoms as they arise, and this only, is a rule of practice which implies the confession of failure to trace the symptom to its cause. It is only in occasional cases that it is necessary or admisable to treat symptoms and even that is but incidental. The symptom is an effect—a logical, and under the circumstances a legitimate physiological effect. It is as much a matter of physiology that the heart rate should be increased when peripheral resistance is at fault as that the heart should maintain a normal rate under normal conditions of peripheral resistance. Pain is a physiological condition under the circumstances of pressure or other cause of sensory irritation, and it is noticeably true of pain that by its presence protection to the organism is secured. In the first place pain is a warning to the consciousness of the individual that something is wrong; second, the location of the pain together with the transference of the sensation gives fairly accurate location of the disturbance; third, pain in numerous cases enforces rest, thereby securing better opportunity for organic repair; and fourth, the pain condition by causing directly, indirectly, or reflexly, increased activity of other parts of the body may further aid in processes of repair.

Fever

The high temperature of fever is a condition that in some respects is directly advantageous to the organism. It is known that in numerous febrile states certain pathogenic micro-organisms play an important role, not necessarily in acting as the original cause of the disorder, but at least in complicating the condition. By laboratory experiment and clinical observation it is found that with many

forms of bacteria a high temperature is directly antagonistic to their development. Hence the high temperature, while a distinct symptom of disorder, is in addition a definite protection to the individual. The profuse sweat which is often associated with fever cases is an arrangement whereby a temporary respite is given to the patient from the great discomfort due to the temperature. In the evaporation of the perspiration the patient is temporarily relieved. The chill, also often found in connection with various acute cases, represents a physiological principle. If a case of malarial fever be examined just at the beginning of the period of the chill, it will be found that the temperature of the body is near the normal. If observation be made shortly after the chill period, or even before that period ceases, a considerable increase in the temperature will be noted. Hence, the chill is a method for increased heat production—a thing very helpful under the circumstances. We know that most of the body heat results from oxidation processes taking place in active muscle tissue. In the chill we have a rapid contraction and relaxation of the muscle tissues of the body with the consequent elaboration of heat. Since the chill is but an exaggeration of the shiver, the explanation of the increase in temperature becomes obvious. In the convulsion we have still another condition where it is probably true that a physiological purpose is fulfilled. Dr. Still has repeatedly emphasized his conviction that the muscular spasm is but nature's effort to produce a redistribution of the forces and fluids. Note the extreme quiet that follows the epileptic spasm. For several hours there is deep sleep during which recuperation is in progress.

Digestive Reactions

Vomiting and diarrhœa are symptoms indicating that there is disturbance to the nerve terminals in the digestive tract. But both are physiological. By the vomiting process the organism rids itself of material which if allowed to pass into the intestinal canal would create further disorder; while the rapid peristalsis associated with the diarrhœa carries onward material which, having gained entrance to the canal, is directly irritant. By this increased motion, absorption of the irritating substance is materially lessened, and hence a definite protection is provided. The anorexia which is likely to be associated with both of these conditions, is a distinct protection in

that it militates against taking into the alimentary canal additional material before the canal has cleansed itself of the irritant and before the assimilative processes are again in condition to function properly. In such a case, the absence of desire for food should be sufficient warning to refrain from partaking. The warning is often increased by a definite nausea which is produced by the mere sight or thought of food. Needless to say, the warning should be heeded, and yet as a result of years of false teaching, there are many who utterly ignore the warning and insist on forcing food upon a properly rebellious stomach.

Pulmonary Reactions

The rapid respiration in pneumonia is another typical symptom. It undoubtedly is a favorable condition under the circumstances. For in this disorder one lobe of the lung becomes incapacitated because of an infiltration into the air sacs and bronchioles of a material through which air cannot pass. As a result the lobe becomes solidified and comparatively little movement is possible. But the demand for oxygen is just as great as before; hence, in order to keep up a proper supply other parts of the lung must be overactive. Thus, by this hyperactivity the organism is protected against a deficiency of oxygen that would otherwise result. In a similar manner increased activity of the heart muscle is called for when a valvular deficiency occurs. In order to keep up a normal circulation with deficient valves there must be an exaggerated heart action. Clinical experience shows this to be the case. And not only does the heart increase in rapidity but it also increases in substance—purely a matter of accomodation resulting from the excess of action. Hence hypertrophy of the heart, while a symptom of organic cardiac disorder, is also a definite protection against failure of the circulation—an evil much greater than an enlarged heart.

Glycosuria

Glycosuria as found in diabetes is a definite symptom of pancreatic disorder. It ought to be present in such a case. In fact the rather abrupt cessation of this symptom in a serious case of disease is a cause for alarm. When the sugar begins to accumulate in the blood it is the function of the kidney to throw it out. The failure of the kidney to excrete is cause for alarm. Associated with the

excess of sugar in the urine there is an increased quantity of the latter excreted—as much as twenty pints or more having been noted. Under the circumstances this is necessary. In order to keep the excess of sugar in solution, fluid must be supplied. The greater the amount of sugar present, the greater is the amount of water excreted with it to hold it in solution. In this case the symptom is an undoubted protection.[1]

Inflammation

In many inflammatory conditions there are certain appearances which suggest a definite protective action. It has been asserted with a good degree of evidence that the serous exudate in an inflamed area is a factor that tends to reduce the pain condition and assist in the healing process. In the case of an inflammation of a mucous surface, as in all catarrhal conditions, there is an excess of mucus secreted. The excessive blowing of the nose in an ordinary acute nasal catarrh is a detriment from the increased irritation thus caused. The exudate should be permitted to remain in contact with the mucosa, and to flow gently outward. In croupous inflammations such as diphtheria, the removal of the membrane is decidedly contraindicated, unless it forms so rapidly and in such amount as to offer serious obstruction to respiration. It is undoubtedly, as indicated by clinical experience and by abstract reason, a real protection to the injured surface.

Cases might be multiplied indefinitely where a peculiar appearance usually mentioned as a symptom, is not only the latter, but also is a protective means employed by nature. Not that every symptom is necessarily a benefit to the organism or that it is evidence that the latter is making the attempt to overcome the disorder. In fact we know that to all appearances there are certain secondary changes that arise which are a disadvantage to the organism. But there are certainly enough cases where a real benefit is derived to warrant the greatest of care in determining whether a

[1]Disturbances in sugar metabolism are produced by lesions of the tenth thoracic vertebrae and neighboring tissues. Such disturbances lead first to lowering of the sugar tolerence, and, later, to definite diabetic symptoms. For accounts of the experiments upon which this statement is based, see the Bulletins of the A. T. Still Research Institute.

For discussions of the chemistry and the physiological mechanism of variations in sugar metabolism and diabetes, see Wells, Chemical Pathology, 1918.

symptom should be combated. Certain it is that the rule of practice to "treat the symptoms as they arise" without first determining the usefulness or the harmfulness of such symptoms, is most reprehensible and has no place in the philosophy or practice of the osteopath.

While it is thus true that in many cases the symptom has a definite value aside from the fact that it is a key to the nature and location of the disease, it is with reference to this latter consideration that the physician finds it of decided practical value. Disease in large part is determined by symptoms, and we may define a symptom as any unusual manifestation in structure or function that suggests disease. The symptom, in case it is one noted only in the sensations of the patient, may be subjective, or where noted by physician or other observer, is objective. As an instance of the former, pain is typical; of the latter the coated tongue in digestive disturbances, the contracted muscle in spinal lesions, or albuminuria in nephritis.

Of the classes of symptoms, subjective and objective, the latter is the one relied upon for determining the details; the former, although customarily first used in point of time, is unsatisfactory. This is true because the subjective symptoms are subjective. Feelings are unreliable signs. The location of the disorder may be far remote from that which is apparently indicated by the sensation. The further fact that in numerous cases patients are unable to locate the sensation or are unable to give an accurate description of its nature, increases the difficulty in the way of a satisfactory diagnosis from subjective symptoms. On the other hand the conditions that can be seen and felt objectively by the physician constitute fairly accurate indications of the disorder, while the tenderness on pressure which is manifest on physical examination gives quite accurate data for legitimate conclusions.

CHAPTER XXIV

METHODS OF EXAMINATION

The methods of examination objectively are those in use by physicians of all schools, although the osteopath emphasizes one, palpation, above all others. First in point of time is the method by inspection, which consists in observing various changes in the appearance of the body, its function and its products, by the sense of sight aided in numerous cases by the microscope, the test tube, X-ray plates, or other apparatus; for instance, a coated tongue, a sallow complexion, and a high-colored urine are seen; by inspection lesions are determined, at least in general, as in the case of the carriage of the head in torticollis, the inversion of the toe in a dorsum dislocation of the hip, or a contracted muscle and deviated spinous process in a spinal disorder.

Palpation

Palpation is the second method in point of time but first in point of importance and consists in determining conditions by the sense of touch. For instance, by palpation we may note an increased cardiac impulse, a difference in the respiratory movement of the two sides of the chest, a tumor of the abdomen, a high temperature in fever conditions, a contracted muscle, a subluxated rib, or a limited movement in articular structures, and by pressure upon a part, though not by the sense of touch of the diagnostican, differences in sensory conditions of the patient may be determined. Osteopaths pride themselves upon the delicacy of their sense of touch and it is well they should, because by no method can the lesion be determined so satisfactorily or certainly as by palpation. If one of the various methods should be developed at the expense of others that one is palpation. It is characteristic of the founder of osteopathy that he made use of palpation almost to the exclusion of other methods, and his ability to detect structural changes with little difficulty by the sense of touch was common knowledge. That there is large possibility of developing that sense will be admitted by all, but to the osteopathic practitioner the fact becomes more

and more striking as his experience and observation extend over a larger period and a wider field.

Percussion

A third method of objective diagnosis is percussion. This consists in the comparison between the sounds produced by a series of light blows over the normal and abnormal organ. Every organ or structure has its specific percussion note which is determined by its density and its relation to adjacent structures or cavities which act as sounding boards or resonance chambers. Various names are given to the different grades and tones of the percussion note; thus we speak of the resonant note of the normal lung, the dull note of the liver, the flat note of abdominal dropsy, or the tympanitic note of the stomach distended with gas. The methods of percussion are immediate (direct), or mediate (indirect), in the former of which light blows with the fingers or a small mallet are delivered directly on or over the tissue; in the latter, which is most commonly used, a pleximeter is interposed betwen the structures percussed and the fingers or mallet.

Auscultation

By auscultation the sense of hearing enables the physician to determine disordered conditions of various of the organs, though by this method the sounds produced by the organs in their functioning furnish the evidence. A change from the usual nature of the sounds of the heart is indicative of cardiac disorder; the respiratory murmur gives evidence of a normal or abnormal condition; the rumbling sounds produced in the intestines technically spoken of as borborygmus suggest overactive gaseous formation, or the friction sounds produced by the approximated pleural layers denote the dry form of pleuritis.

Mensuration

Mensuration is a method much employed by osteopaths, not only in the way of definite tape-line measurement, which is often helpful and occasionally essential, but by comparison in size and shape of paired or symmetrical structures. The difference in size between the sides of the chest is often noticed; the difference in the width

of the ilio-costal spaces is valuable in numerous cases; the shortening of a lower limb through lesion at the hip or pelvis is noted by measurement or comparison; the increased circumference of the shoulder joint is diagnostic of a dislocated shoulder.

Instruments

For certain cases, many other methods may be employed. The thermometer gives accurate determination of temperature; the sphygmomanometer gives blood-pressure accurately; the sphygmograph gives accurate information as to valvular conditions of the heart; various instruments for illuminating and exposing to view the naso-pharnyx, auditory canal, retina, rectum, and other orifices of the body very often give information not to be secured in any other way. The various methods of laboratory diagnosis are indispensable.

The ordinary medical physician requires only a diagnosis of the name of the disease from which the patient suffers, and his medicines are administered accordingly. But the osteopathic practician must know the entire condition of the patient, and this means that osteopathic diagnosis is necessarily more thorough, more accurate and much more important in determining treatment than is medical diagnosis.

These methods modified and aided by pressure and rotation of parts either singly or collectively yield sufficient data to indicate the essential nature of most of the disordered conditions which the physician meets. All of them have their uses and their special value and the osteopath who entirely neglects any will certainly find occasion to regret his inability to make satisfactory use of that method.

It is inappropriate to further discuss the question of symptoms in the diagnosis of special diseases. It is necessary at this time to take up for discussion the diagnosis of lesions. A consideration of this question is distinctly and peculiarly osteopathic since it is only the osteopath who has recognized the existence of the lesion, at least in the special use of that term which has been indicated in another chapter.

CHAPTER XXV

THE DIAGNOSIS OF LESIONS

The special and limited meaning of lesion is an osteopathic creation and hence it will be necessary to go quite into detail in the discussion of the factors entering into the determination of the presence of a lesion in any specific case. The fact has been emphasized that not every malposition of bony or other structures constitutes a lesion. In a few cases such a condition may be the only evidence of lesion and still be a real lesion in the two-fold idea assigned to that word, structural change, producing functional disorder, but in the majority of cases with which the osteopath deals there will be other evidences which substantiate the diagnosis. Further, in this discussion it is not advisable to take up in detail the different forms of lesion as they may exist separately—bony, muscular, ligamentous, visceral—but the consideration will be limited to a typical case where there is a combination of the first three named. For it cannot be too strongly emphasized that in most conditions of skeletal disorder the three will be associated in the causation of the functional perversion. In this discussion the presence of such an association is assumed, and the points essential in the diagnosis of that condition will be indicated.

Examination

There are two fundamental methods of procedure to be noted in making an examination of any part of the body, the one of which will tend to prevent possible error arising from the other. The part should be examined in its (1) functional activity. A perverted function is manifest in the appearance of the action of the organ which performs the function. In torticollis or wryneck the sternomastoid muscle presents an appearance when in action entirely different from that while at rest. Comparison of the muscle in the horizontal position with it in the erect position of the body suggests facts that otherwise escape attention. In the horizontal position the neck muscles are in (2) functional rest. In the examination of a

hip the action of it should be noted, but in addition the position of its various parts should be determined by palpation during its rest. The movement of the chest should be noted and compared with that of a normal action, but in addition there should be noted the position of the ribs while in expiration and pause. The movement of the inferior maxillary may suggest the nature of the lesion less noticeably than an examination of it in the quiet state.

Perversion of Function

Passing to the details in diagnosis it will be noted that the first evidence that a lesion exists is the perversion of function of some organ or structure, which is likely to be first discerned by the patient or some one other than the physician. The patient gives the information that he has functional disorder of some special organ. That fact indicates in general the part of the organism where lesion is most likely to be found; if it be gastric disturbance the splanchnic or the vagal region will be suspected; if a uterine trouble, the lower thoracic, the lumbar, or sacral structures are first examined; if the eye be impaired, the atlas and the upper thoracic are more likely disturbed.

Attitude

The general attitude is a factor in the determination of the approximate location of the lesion. Dr. Still has emphasized the fact that the position that a patient assumes is normal to the existing structural condition, which is but a special application of the doctrine that function is normal to structure. To make a concrete case, suppose a lesion of considerable magnitude exists in the cervical muscles of the patient. The manner in which he carries the head suggests a cervical lesion. If a rib be subluxated the patient sits in such a position as to secure to him the least irritation. The careful way in which an individual afflicted with Pott's disease carries his body immediately suggests a spinal lesion. In all of these cases the position or the attitude is the result of the lesion; that is, the lesion or its effects compel it to be such. Hence the value, when a patient presents himself for examination, of making a preliminary survey of the individual as a whole.

Landmarks

The position of landmarks is a third point to be considered. Having determined the probable region of the lesion by the method above described, a peculiarity in the positional relation between certain parts used as points for comparison may be noticed. In the case of a vertebra, the relation of its spinous process to those adjacent may be altered; the intercostal space, in case of a rib, may be found to vary in regularity throughout its extent, or may be narrowed or widened in comparison with those above or below; the lower margin of the liver, in malposition or enlargement of that organ, is displaced. It seems necessary to emphasize the fact in this connection, that no greater mistake can be or has been made than that of assuming the existence of a lesion whenever it is found that there is a variation in position of a structure. Reference has been made to the fact that structure as well as function can vary from the average within wide limits and still the condition be a normal one. While it is convenient to compare the body to a machine and insist that in both cases a variation of the slightest degree in structural parts will cause disorder in the one as in the other, the comparison is not illuminating if carried to extremes. The machine is an unyielding structure and has no power of adjustment, which makes the necessity for perfect structural alignment an absolute one. The living machine, on the other hand, is made up of yielding parts and has marked possibilities of adjustment to structural changes. The universal tendency on the part of the beginning student seems to be to make the assumption—unfortunate as that fact may be—that every unusual situation of a bony land-mark is abnormal. In some cases it would seem that the apparent structural change is, of all the several evidences of lesion, the most unreliable.

Sensory Perversions

A further evidence of the presence of the lesion is the sensory change. While this usually takes the form of a definite pain, in many cases it is of the nature of such sensations as anæsthesia, hyperæsthesia, or paræsthesia; under the latter term is included the burning sensations, tightness of tissue, or of formication, i. e., sensation as of a small insect creeping over a part. Any of these

may be present either at the local area of the lesion or may be remotely situated and partake of the nature of referred sensation.

Pain is of such importance that it is necessary to enter into detail showing its relation to lesion and disease. It is a sensation, perceived by the cerebral cells concerned with consciousness, produced by irritation of the sensory nerve. There are specialized nerve endings, nerve fibers, and nerve pathways in the cord for sensations of pain; while it appears also that any afferent nerve sufficiently irritated gives the sensation of pain. Note the fact that the sensation is a brain function though it is usually projected to the part irritated. For instance, the sensation from a burned finger is felt in the sensorium but the individual is entirely aware that the irritation is at the finger. With reference to this fact, note the want of logic in the reasoning of the individual who is content with giving a drug which renders the sensorium less capable of receiving or responding to the transmitted impulse. The pain is still present in so far as the nerve disturbance constitutes the pain. The drug has simply rendered the patient unaware of the existence of irritation. Pain, then, is a distinct advantage to the organism, and it is in relation to its advantage in the way of assistance in the diagnosis of the lesion that it will further be discussed.

CHAPTER XXVI

PAIN IN LESIONED AREAS

It is to be noted that pain may be direct as when caused by irritation produced directly upon the part to which the sensation is projected. For instance, an irritant taken into the stomach may cause the sensation noticed in that region; or pressure upon the ulnar nerve cause pain at the point of pressure; a contracted muscle—e. g., the pyriformis, may irritate directly the sciatic nerve and the whole nerve suffer. In this case the pain is felt not only at the point of pressure but throughout the entire nerve trunk; for note that in the pressure on the ulnar, while the pain may be at the point of pressure, it is likely more noticed in the finger, i. e., at the peripheral end organs. In this case it is not necessarily simply a reference by consciousness, but an actual disturbance of molecular vibration throughout the entire nerve element, and the greatest intensity of impulse will seem to come from those parts which are especially developed for the purpose, as the sensory endings in the periphery.

Referred Pain

The pain may be indirect or referred. In this case a peculiar fact is to be noted, a fact that has been put in definite formulation by Head and which is spoken of as Head's Law. This law states that, "When a painful stimulus is applied to a part of low sensibility in close central connection with a part of much greater sensibility, the pain produced is felt in the part of higher sensibility rather than in the part of lower sensibility to which the stimulus was actually applied." While this is a fairly correct statement of the real condition it should not be dignified by the name of law, since in the above wording it cannot apply to all cases by any means. Head based the law on observations with especial reference to visceral versus spinal pain. It is known that many of the viscera are comparatively insentient under ordinary conditions. That is, the nerves capable of conducting an impulse producing the sensation of pain are comparatively few and inefficient, and hence the irritation sufficient to give pain must be correspondingly intense. But every one is aware that pain may be produced in a viscus and definitely projected to that viscus, and in

order to show that Head's Law holds, it must be proved that the part of higher sensibility is the part most noticed by consciousness on the application of the stimulus to the more insentient organ. That such is the case in numerous instances may readily be admitted but that it is true in all is disproved. Were it stated that the pain may be felt in the part of higher sensibility the objection to the statement would cease. In this latter interpretation the question will be considered. Note that the law provides for a condition where there is a "close central connection."

Anatomical Relations

Though little evidence of an anatomical nature can be adduced, there is much from physiological and embryological investigation to show that the spinal cord and less noticeably the brain are segmental structures. The cord may be arbitrarily divided into segments corresponding to the paired arrangement of the spinal nerves, and we may assume with little probability of error that this division represents a physiological segmentation. That each part of a segment acts more with reference to its other parts than to parts from an adjacent segment, is a statement that is true in general. Hence, two nerve fibers having their central endings in the same segment will be in more intimate relation than fibers from different segments. This fact is indicated from various evidences derived from experiment, especially in reference to reflax action. For instance, Pfluger has shown that a stimulus applied to a limb of a "spinal frog" produces its first response in motion of that limb, but the next effect, produced by a stronger stimulus, is upon the limb of the opposite side, showing the radiation of the impulse to parts in the same segment. An additional stimulus causes effect on nerves from the immediately adjacent segments. But according to Head and others who have investigated the same problem, the phenomenon is not limited to a reflex mechanism such as is present in the above cases. A sensory nerve in connection with the same segment may be involved, or at least the pain may be referred to the area of distribution of that sensory nerve. Head calls attention to the fact that with a few possible exceptions, each viscus is related in this way to a definite area of cutaneous tissue. For instance, irritation of the stomach is likely to be associated with pain in the skin areas supplied by afferent fibers from the sixth, seventh, eighth and ninth

thoracic nerves. It is significant that the pain is not necessarily of a simple "referred" or "transferred" character. It is noted that in numerous cases there will not only be referred pain, but what is a different thing, so called referred tenderness, in which case it is suggestive of distinct nerve disturbance rather than a reference on the part of consciousness.

The reference of pain is not necessarily from a diseased viscus. Osteopaths continually have this fact called to their attention by numerous cases. Hip trouble gives rise to pain in the knee. This may be due to direct pressure by the luxated structures or localized edema upon the nerve supplying the articulation, or it may be due to impingement upon the terminals of branches distributed to the hip-joint referred back to the segment, and thence out over the branch to the knee. For we know that the same trunks which supply the articular structures of the hip also supply those of the knee. Similarly Hilton[1] calls attention to the fact that the same nerve trunk that supplies a joint, also supplies the skin which overlies it and the muscles that move it, and a further usual circumstance of interest, that the bowel wall, the peritoneal structures associated with it, and the skin overlying these, are supplied from the same segmental source. Earache may be associated with disturbances in the nutrition of the teeth, both of these structures being supplied by the fifth cranial.

Central Origin of Pain

In all of these cases there is a principle that is similar if not identical—it is a physiological principle operative in a distinctly beneficent way under ordinary circumstances. Parts thus intimately associated anatomically are made to act in harmony not only in normal but in abnormal conditions. Further facts suggested by Hilton in relation to referred pain may be of some value. He notes first that pain in the superficial structures not associated with a high temperature of the part is suggestive of a distinct origin of the pain, and usually that origin is in the spine. He instances in this connection what osteopaths have been able to corroborate in many cases, that a sensory disturbance in the anterior terminals of the thoracic spinal nerves is often due to a spinal lesion, no local dis-

[1]Hilton: Rest and Pain.

order being manifest. A further rule is that when the pain is symmetrical it is almost certainly caused by a central disorder. The application of the foregoing facts is apparent. By means of the pain or tenderness we may trace the situation of the segment of the cord which is involved. That involvement may be or may not be dependent on a lesion at the corresponding vertebra, but in the majority of cases such a lesion is found. Even though the definite structural change be absent from this part, the organ involved is indicated and indirect aid is given in the diagnosis.

Hypersensitive Areas

The tender spots, for the discovery of which the osteopath is famous, are always significant. In most cases these points of increased sensitiveness are quite limited in extent and suggest not a referred but a direct irritation. For instance, in the examination of a lesion of the spine the tissues at the region between the spinous and transverse processes are tender on pressure. This is always suggestive of local disturbance, congestion, inflammation, or edema of tissues sufficient to irritate the sensory nerve terminals in the part. In palpation for such tender areas care must always be exercised or a tender spot may be produced where none before existed. Bear in mind that sufficient pressure in any part, whether normal or abnormal, produces pain or some other sensory change. The sensory condition of the part under examination must always be compared with similar adjacent areas and with the average condition. This last may be a question of experience—the average normal condition must be learned before there can be much possibility of detecting slight changes—a statement true not only with reference to pain but to all the several factors enumerated.

CHAPTER XXVII

MUSCULAR CHANGES IN LESIONED AREAS

Another valuable factor in determination of the presence of a lesion is the condition of the associated muscle tissue. This is usually spoken of as a contracture, the causes of which have been referred to in the section on causes of lesions. It becomes necessary to distinguish between the meaning of contraction and contracture in order that confusion may not arise. The term contraction refers to the state of a muscle in the physiological process or condition of shortening and thickening.

"Voluntary muscular contractions are actually tetanic, that is, even our briefest muscular movements are the result of a series of stimuli sent into the muscle at regular intervals during the continuance of its contraction . . . It must be evident, therefore, that the motor cells innervating a muscle always discharge a series of impulses which give rise to a serial evolution of muscular energy . . . These statements may also be applied to the tonus of a muscle, with this modification, however, that the stimuli upon which the tonic condition of muscle depends are of subminimal intensity . . . The term contracture signifies that the relaxation of the previously contracted muscle is unduly prolonged, or, as may also be said, that its contraction is maintained for an abnormally long time. This condition is frequently encountered during fatigue, or when a fresh muscle is cooled, or is subjected to excessive stimulation."[1] Such muscles may be found in hemiplegia, hysteria, under the influence of veratrin or certain other drugs, and in the neighborhood of vertebral lesions.[2] Unless degenerated, such muscles react to stimuli by diminished, though otherwise normal, contractions or tetani.

The term contracture is also used by certain authors in a different sense: a muscle subjected to chronic inflammation undergoes increase of connective tissue, becomes shortened, and the muscle undergoes atrophy. In lower neuron paralysis, the muscles undergo

[1]Burton-Orpitz: Physiology, 1920.

[2]Bulletin No. 4: The A. T. Still Research Institute.

atrophy, and the muscles become shortened and infiltrated with connective tissues. Muscles under both conditions are said to be contractured.

The term rigor is also applied to muscles affected by vertebral lesions. Such muscles are swollen, subalkaline, edematous, congested, hypersensitive, more extensible than normal, and give diminished response to stimuli. The muscle gives a sensation of irregularity to the examining fingers; the muscle seems ropy, and welted and lumpy, while between these hardened areas there is a peculiar dense quality; due, no doubt, to the edema. On microscopic examination, such muscles show edema, cloudy swelling of the muscle cells, dilatation of the capillaries, with some hemorrhages per diapedsin. Similar conditions are found in rigor mortis during the early stages, during rigor caloris, and water-rigor, as well as in rigor due to the action of certain chemical substances.

Such muscles are hypersensitive in experimental animals, as well as in human beings suffering from bony lesions. Emphasis should be laid upon the fact that a persistent contraction or contracture invariably results in a sensory disorder of some kind. Finally, material aid may be given in the determination between a muscle physiologically contracted and one in contracture by causing the individual or part to assume a position in which the necessity for physiological contraction ceases to exist. For instance, so long as the individual is in the sitting posture the deep cervical muscles are functionally active. On assuming the horizontal position the necessity for their contraction ceases to exist and they normally relax. If, however, the muscles be contractured or in rigor, the relaxation on changing position will not be so apparent. Note that it is a condition of degree, for the abnormal muscle undergoes partial relaxation when its contraction is no longer needed.

Amplitude

The amplitude of movement is a factor of much value in diagnosis of the lesion and one which is closely associated with the condition of all structures. It was noted that in typical lesions bony, ligamentous, and muscular changes are associated and interdependent. All three are concerned in producing the change in the freedom with which the part moves. A bony luxation usually lessens

the extent of movement and so do ligamentous strain and muscle contracture. On the other hand a lax ligamentous and muscular condition permits excessive rotation. The condition of the spine spoken of as a rigid spinal column is a case in point. The rigidity may be due to "locked" vertebrae—rare—thickened and hardened connective structures, deposits in or absorption of intervertebral and articular cartilages as in articular rheumatism, or to simple but general functional muscle contracture, in the latter case usually yielding on application of measures designed to relax the muscles. Bony ankylosis is a condition occasionally met with and will manifest itself by absolute mobility. The X-ray is of great service in distinguishing between these conditions.

Temperature Changes

Temperature change in the local part is often found and usually is indicative of local lesion. The existence of a lesion means local irritation. Irritation results in hyperæmia and hyperæmia may pass into inflammation. In either of the last two conditions there is increased heat because of increased blood, the latter being the principal medium by which heat is distributed.

The increased temperature may be locally produced. Especially is this likely where local inflammation is present, the increased metabolic changes being responsible for an increased oxidation with liberation of heat. Attention is occasionally called to a rib lesion through the difference in temperature along the course of the rib as compared to that above or below. It is not necessarily an increase but may be a decrease in temperature that is noticed. A cold state of the posterior cervical structures is a common accompaniment of lesion in that region. Dr. Still calls attention to the fact that there is a lowered temperature of the skin in the gluteal and lower spinal regions in case of croup, while the ventral structures may show an increased temperature. The numerous cases noted and the equally numerous possible causes of changed temperature suggest the importance of a careful training of the fingers in the temperature sense.

Finally, the color of the part under suspicion may be an indication of a lesion. In most cases the difference in color is dependent on the amount of blood present, congestion causing redness, isch-

æmia producing pallor. Pigmentary deposits may occasionally be noted in the region of a lesion, from the blood or other change associated.

In all the examination for the nature and location of a lesion the several factors mentioned should be borne in mind. In the vast majority of cases only a few of them are appreciably present. The greater the number the more certain the diagnosis. The absence of one or all does not disprove the presence of a real lesion and a serious one but renders its presence less easily recognizable. Note the fact that numerous osteopaths are quoted in the expression, "There was no lesion in the case." The want of logic evidenced by such assertion is quite apparent. To assume that every lesion can be detected is to assume the impossible. Lesions may be microscopic and still be lesions as judged by our definition, and he who thinks it necessary, in the case of imperceptible lesion, to assume the existence of some other cause for the disorder than that of the lesion, or that the manipulation of a part which produced a cure of the disorder did so otherwise than by removal of lesion, is making use of extremely faulty logic.

CHAPTER XXVIII

THE TREATMENT OF DISEASE

Prophylaxis and Therapeutics

The ultimate end which is kept in view in the determination of the etiology and diagnosis of disease is to establish a rational basis for the treatment of disease. By the treatment of disease is meant any method or measure which will assist the organism in re-establishing its normal function. More appropriately, it is the treatment of the diseased organism rather than the treatment of disease, for the disease will be disposed of by the organism itself if freedom is given to the healing agencies inherent in the organism. Broadly speaking, there are two grand divisions comprehended in the word treatment, one of which is concerned with all those measures designed to prevent the onset of disturbed functioning. Technically this is spoken of as prophylaxis.

The term prophylaxis is a comprehensive one and has rather indefinite limits. In the first place it is concerned with the conditions of the environment of the individual. Sanitary measures employed by a municipality, including regulations governing sewerage systems, tenement house requirements and the like, constitute definite prophylactic treatment applied collectively. Hygiene in the nature of cleanliness, normal exercise, and the breathing of pure air or the eating of proper food in proper amounts, constitutes prophylaxis of the individual in connection with his environment. On the other hand prophylaxis is applied directly to the organism itself either by the removal of the predisposing cause, as for instance the increasing of the chest capacity by lifting and adjusting the ribs in order to avoid furnishing suitable soil for the propagation of the tubercle bacillus; overcoming the irritability of the mucous membrane of the nasal passages to prevent an attack of hay fever brought on by the presence of dust particles in the air; or insistence on abstaining from further abuse of an organ which otherwise would ultimately

result in exhaustion and hence disease, for example, where there is a tendency to writer's cramp; or prophylaxis is applied in the avoidance of the exciting cause, or the direct destruction of that exciting cause. As illustration of the latter, the patient may be directed to move to a climate more favorable to his health, as in the hay fever victim who passes his summers in an atmosphere less laden with irritating particles; or the use of antiseptic washes in the case of contagious diseases.

Measures may be applied in the treatment of the organism after the disease is present and this constitutes what is technically spoken of as therapeutics. It is necessary to observe as a precaution that many writers make use of this term to embrace both preventive and curative treatment. As a matter of convenience the two terms should be kept within their proper limitations. In the application of therapeutic treatment one or both of two policies may be pursued, the removal of the lesion condition or the abstinence from any use of the organ that under the circumstances would constitute an abuse. In the case of an individual afflicted with stomach trouble dependent upon a splanchnic lesion the proper treatment for such disorder would consist in the removal of the specific lesion. So long as the lesion exists some care may be necessary to avoid any overwork or other abuse of that organ. If on the other hand the primary cause of the gastric unrest is abuse by errors in diet, therapeutics would consist—granting there was no lesion present—in the regulation of the dietetic habits of the patient.

Of the two ideas associated with treatment, that of prophylaxis occupies the higher plane, for prevention is always better than cure though not necessarily in the ratio of the ounce to the pound. It is the dream of the idealist that a time may come when there will be a greater demand on the part of the people for prophylactic than for therapeutic treatment; when the individual will pay greater attention to laws of health and will go at frequent intervals to a qualified physician for the purpose of physical examination to detect any predisposing lesions that may have arisen since the last examination or treatment. But the dream of the idealist will hardly be realized in this generation. The average osteopath is called

upon to treat a case only after the evidence of disorder is markedly present. Hence relatively greater stress must at present be laid upon the therapeutic side, except that the physician may make himself a distinct force for the dissemination of knowledge regarding the body and the laws of its health, together with a hearty co-operation with all legitimate efforts to enforce sanitary measures applied collectively to a city or community.

Lesion in Prophylaxis

The relation that the removal of lesion bears to prophylaxis, even in case of a therapeutic treatment, the author has discussed in a former article, a part of which is reproduced in this connection: "But after all that may be said of the curative treatment, is not every osteopathic treatment a prophylactic one? The use of the term curative is essentially incorrect. The physician does not cure. We object to the definition of osteopathy which affirms that the physician 'directs' the inherent recuperative forces of the body. The direction of those forces abides in a higher and more subtle power than can be exercised by the hand of another individual even though it may be guided by a high order of intelligence. Neither does he 'regulate functioning,' except in a secondary sense.

* * Functions are controlled by an inherent force which we denominate vital. That force itself cannot go permanently wrong. It will not cause permanent disorder of structure except it be hindered by blocked channels of interchange. And herein lies the fallacy of the Christian Scientist and all other mental healers. The 'tendency to the normal' operates in psychic as well as in material substance, and the normal in mind and emotion will be assumed if the organization of cell life be intact. If then the physician does not regulate functions or direct forces, what does he do? Fundamentally, he clears the way. Does that cure? The disease as it existed before the lesion was removed was caused by perverted function resulting from the lesion. On the removal of the lesion the disease as it exists is overcome by the restored normal functioning. The physician in removing the lesion has prevented the further progress of the disease. He has applied preventive treatment.

"Is it the assertion of an extremist to say further than that even in the removal of a lesion the physician is not overcoming a structural condition? In the vast majority of cases which the osteopath meets, the treatment does not consist in setting a bone, if we use that term in the sense in which it is commonly used. In a case of a recently luxated hip the osteopath may be successful in one treatment. In such a case he perhaps is not simply aiding nature. But in the countless other lesions met with, chronic changes are present which do not admit of immediate replacement. In such cases the prime importance of the physician is as an assistant to the organism. Where a lesion is produced by whatever cause one of several things takes place. Nature first attempts to overcome the structural disturbance and is usually successful. Every football player and every one who has watched the game will readily believe that numerous structural conditions are produced during the strenuous periods. Do every one of these need a treatment? Hardly. Tension of tissue supplies sufficient treatment. But occasionally a structural disorder is sufficient in degree to pass the limits of self-adjustment. Failing in drawing the part back to normal the tissues on one side gradually yield, on the other gradually shorten, and with other changes a partial adjustment to the new circumstances takes place. What must the osteopath do? In the case where nature is still making the attempt to re-align, he can release the hindering structures and in the average case 'nature will do the rest.' In this case he is not curing; he is preventing. Where complete adjustment to the changed condition has taken place he is perhaps more surely applying a curative measure in the breaking up of adhesions and stretching permanently shortened muscles and ligaments."[1]

Corrective Versus Palliative Treatment

A further classification of treatment is made having reference to the immediate purpose and effect, as to whether it be corrective

[1]Journal of Osteopathy, Nov., 1902. The Ounce of Prevention.

by virtue of aiding in the removal of the cause of disease, or whether it be palliative, in which case it is directed to a symptom rather than a cause. If the physician overcomes or assists the organism in overcoming a lesion of the spine which is causing heart disorder, or if the patient himself abstains from the abuse of his heart by over exercise where such has been the cause, a corrective treatment has been applied. If on the other hand he exerts pressure in the upper thoracic region and relieves a temporary palpitation or thoracic distress, a palliative treatment has been employed. Often no definite dividing line can be made between the two, for a corrective treatment is in a large number of cases palliative also. The adjusting of the ribs by the treatment in the thoracic region, thereby taking off the pressure, will give relief to the distressed cardiac structures. On the other hand in numerous cases a palliative treatment, while given explicitly for the purpose of temporarily overcoming a symptom, may in the long run be corrective as well. A treatment applied for the purpose of lessening the intensity of pain will in occasional cases give to the organism a better opportunity for repair, which was wanting so long as the nerve disturbance continued. Further, it may become necessary that a palliative treatment be given in order that the primary cause may be reached. For instance, an obstruction to the bowel from impaction may cause such a tension of the abdominal wall as to make impossible any direct manipulation of the impacted area. In such a case treatment would be given for the purpose of relaxing the abdominal muscles which would be preparatory to the primary or corrective treatment. Or in the case of a wrenched spine the resulting congestion and contracture of the superficial spinal muscles may be such as to hinder treatment to the deeper structures, making it advisable if not essential to quiet the sensory disturbance and overcome the contractured condition before attempting the deeper work. Again, a palliative treatment may be essential as a preliminary to further diagnosis. In appendicitis the bowel wall is so irritable and tense as to prohibit palpation deep enough to determine the condition of the cæcum

and appendix; or the superficial cervical tissues may be so contractured as to prevent the detection of a deep cervical lesion. In both of these cases the palliative or temporary treatment is necessary before a satisfactory diagnosis is possible.

CHAPTER XXIX

ADJUSTMENT OF OSSEOUS LESIONS

The statement has been made that the three common forms of lesion, bony, muscular and ligamentous, are usually associated in the production of the same disorder. In the treatment of the condition a movement which affects one affects the others. In the case of the bony and the muscular lesion at least, special and peculiar methods are used. The ligamentous lesion can be affected only by work upon the others. Since we do find bony and muscular lesions associated the question arises as to which should have precedence in point of time. It must be confessed that there is a difference of opinion regarding the matter. If the bony disorder is secondary to the muscular tension and is maintained in its position primarily by that muscular tension, manifestly the muscles should first be relaxed, and if no other cause of bony displacement be present that may be sufficient. Such a condition is a common occurrence in acute cases and hence the general rule that muscle contracture should have first attention in acute cases may be safe enough to follow. In chronic conditions, however, the vast majority of cases present bony disorder not primarily maintained by muscular contracture; and in most cases the muscle contracture is secondary to the bony disorder though in the beginning muscular contracture may have been primary. In such cases as these the author is personally convinced that direct treatment to the muscles is secondary in point of time and importance, and so far as actual results are concerned the massage so often employed is entirely superfluous. The discussion will be begun therefore with a consideration of a few general principles underlying the adjustment of the osseous lesion.

Exaggeration

The first of these principles may be spoken of by the phrase which osteopathic usage has authorized, exaggeration of the lesion. By this is meant a manipulation designed to make the structure more prominent in the direction toward which it is displaced. For

instance if there be a right lateral subluxation of a cervical vertebra the head should be flexed to the left and pressure applied to the cervical tissues on the left of the displaced bone; if a rib is subluxated upward on the transverse process of the vertebra, pressure is exerted upward at the angle of the rib and downward on the anterior extremity; if the innominatum be subluxated through a rotation upward and forward, pressure is exerted in an upward and forward direction on the iliac portion of the bone, upward and backword on the ischium. In the exaggeration of the lesion several objects may be had in view. In the first place the measure tends to free the articular structures, just as driving in a trifle may free the articulation of a nail with wood in which it is imbedded and permit it to be withdrawn more easily. In the second place the movement effects a stretching and relaxation of the deeper structures which in numerous cases is all the relaxation that is called for. Finally, there is secured the benefit of recoil which results from the stretching of the tissues and aids in initiating the movement backward towards the normal position.

Rotation

A second general principle is that of rotation. The value of rotation can hardly be overestimated although the rotation itself may easily be too extreme. In effecting rotation of the part disturbed, at some point during the circuit each of the fibres in each of the ligamentous and other connective structures will have been stretched and relaxed and the articular surfaces kept sufficiently free to allow the progress of the part back to its original position. The comparison may be crude but the conditions in the case are similar to the movement of a trunk or box along a platform by rocking it back and forth with some rotation. The advantage of this method over that of dragging the box bodily is obvious.

Pressure

A final general principle in the adjustment is the simple one of pressure applied to the displaced structure in the direction toward its normal situation. In point of time the exaggeration of the lesion is first, rotation and pressure follow and are co-extensive and co-ordinate in time. In all but a comparatively few cases these

three principles can be applied with advantage, and are applied although the physician himself may not have been aware of their application. In a few cases little direct pressure can be satisfactorily made, and in case of an anterior lumbar vertebra, it is necessary to rely principally upon the tension of tissues in and following the process of rotation. In other cases the exaggeration of the lesion may not be feasible; but in no case is it impossible to apply rotation and in numerous conditions where the lesion is slight, that of itself is sufficient aid to the organism in affecting a normal adjustment.

CHAPTER XXX

ADJUSTMENT OF MUSCULAR LESIONS

In most cases of a chronic nature and in practically all acute cases muscular lesions are quite manifest. It is not necessary at this time to discuss the question as to whether that lesion is primary or secondary; the fact that it exists calls for discussion as to the methods of producing relaxation. For whether the lesion be primary or secondary its removal is seldom if ever contraindicated. Note first that one or more of several purposes may be had in view of the relaxation.

Relaxation for Diagnosis

One of the objects in such relaxation is that of diagnosis. In a large number of cases the muscular lesion is the most apparent one, which fact has given rise to much hasty reasoning with the conclusion that no additional factors were present. The writer was once told when he was a student in school, that when he "got into the field" he would find little beside muscular lesions. He is compelled to testify that the informant has proved himself a false prophet; if care be taken in analysis of conditions few acute or chronic cases can be found present unassociated with deeper than muscular lesions. Indeed it is not unsafe to assert that in most cases the muscular contracture is direct evidence of a deeper lesion. The difficulty of detection may be much more marked than the realness of the lesion. The fact that a deeper lesion is usually associated makes it necessary, or at least in many instances helpful, to effect a superficial relaxation in order to detect the deeper condition. Note the case of a contractured cervical region. In such the osteopath may not be able to determine the condition of the cervical vertebræ until the obscuring muscle contracture is removed. It is often difficult, further, to detect the relative position of the posterior part of a rib at its junction with the transverse process of the vertebra until the associated contracture is overcome.

A floating kidney as a lesion is often obscured by contracture of the quadratus lumborum and abdominal muscles. Not only for diagnosis of further lesion is removal of contraction and contracture necessary, but also for determination of the organ involved and

the nature of the involvement, in other words, for diagnosis of the disease itself. Note the fact that in hepatic colic from the passage of a gall-stone, muscle contraction is so intense and painful that a palliative relaxation becomes imperative for definite diagnosis of the gall-stone condition; similarly an obstruction to the bowel produces secondary abdominal tenseness sufficient to prohibit palpation; the rectal and vaginal sphincters may be so constricted as to hinder local examination of the position and condition of the uterus. In all such cases the osteopath often finds it necessary to resort to the removal of the secondary obscuring lesions before he is able to make a satisfactory diagnosis of the disease.

Relaxation as Preliminary to Treatment

A second object is as a preliminary to further treatment. Dr. Still invariably allowed his fingers or palms to "sink in" the tissues for a moment previous to the movement for adjustment of a cervical vertebra; in this "sinking in" relaxation occurs which reduces the vaso-motor mechanism to the part involved. Relaxation of the pressure. In long standing cases of hip dislocation where a crude new articulation has been formed with a consequent adjustment—shortening and lengthening—of muscle and ligament, it is impossible to immediately reduce the dislocation, and recourse must be had to a series of treatments designed to relax and otherwise change structural conditions which are secondary to the original dislocation. In bowel occlusion from impaction of feces, relaxation of the abdominal wall is essential to a further direct manipulation of the impacted area.

Relaxation of Primary Lesions

Finally, relaxation is used as a treatment primary in itself. A muscle contracture whether primarily or secondarily produced exerts pressure on tissues within itself, (e. g., sensory nerve terminals) or disturbs structures to which it is attached. As instance of the former note the conditions of congestion produced in the respiratory canal by virtue of contractures irritating afferent nerves which carry impulses to the segment of the spinal cord governing the vaso-motor mechanism to the part involved. Relaxation of the muscle tissue in such a case removes the primary cause of the congestion. By the tension upon the associated vertebra or rib, dis-

placement of the latter further adds to the difficulty and hence is additional cause; in this case the relaxation permits of a return of the displaced structures to their natural relationship. Further instances are relaxation of supra-hyoid muscles which interfere with venous return from various cephalic structures, thus relieving congestion; pressure on the bowel wall in a spasmodic contraction of the muscular coats which relaxes the tissue and overcomes the cramp which so distresses.

Methods

With regard to the methods employed in producing relaxation several are in vogue by different osteopaths. Among them mention may be made of the most important. The removal of the cause constitutes in all cases the fundamental method. Owing to the tendency on the part of students to overlook the fact it seems necessary to emphasize that a contracted muscle remains in that state only by virtue of a continuously acting stimulus. A muscle in a state of rigor may remain in that state indefinitely, or until correct circulation removes the abnormal fluids from around its cells. One of the inherent properties of muscle tissue is the ability to respond to a stimulus by a contraction. It is no less an inherent property of that tissue to relax as soon as the stimulus is removed.

In muscular rigor, the removal of the cause of edema, the restoration of normal circulation and normal alkalinity of the fluids, the restoration of normal innervation, permit the injured cells to return to normal conditions, unless the rigor has persisted so long as to cause definite over-growth of connective tissues and atrophy of muscle cells,—the condition of contracture in the common significance of that term.

With a certain proportion of students and inexperienced osteopaths the first consideration on meeting with a case presenting contracture is the application of methods direct to the muscle designed to produce relaxation. This is fundamentally erroneous. The first consideration should be the determination of the nature and source of the constantly acting stimulus. The second consideration should be the application of measures to remove that stimulus. If a muscle is contracted through simple exposure to a change of temperature the primary treatment is the negative one of removing the patient from the influence of the changing temperature. If the contraction or contracture is caused by a direct irritation to the motor nerve

through pressure from a deep bony or ligamentous lesion, the essential treatment consists in opening up the space which transmits the nerve. A contractured condition of the anterior muscles of the thigh caused by impingement upon the anterior crural is logically and surely overcome by the adjustment of the subluxated hip, pelvic, or lumbar structures causing the impingement. Note that the direct work upon the muscle in any of these cases will be getting at the difficulty from the wrong side and can only indirectly and in most cases temporarily reduce the contracture.

Pressure

Admitting the logic of the above considerations it yet remains a fact that specific methods, other than those directly concerned in the way indicated above, may be employed as a matter of expediency. Pressure with quiet and slight rotation of the tissues, usually more in a direction at right angles to that of the fibres than otherwise, is employed in numerous cases. This method secures normal condition of the muscle by acting upon its fluids. Venous blood is forced out, and arterial blood returns; edematous fluids are carried away; alkalinity is brought to normal by the blood flow, the tension due to turgor diminishes, and the muscle resumes its normal metabolism.

As examples of cases in which the pressure and manipulation method is efficacious are the following: in headache the suboccipital region is often found quite tense, in which case gradual but deep pressure, a "sinking in" as Dr. Still calls it, forces the tissue to relax and often yields immediate relief. In case of the passage of a gall-stone along the duct the irritation is so intense as to cause direct connection along the duct, the abdominal wall overlying it, and the spinal region from which it is innervated, in which case pressure is used both along the spine and the course of the duct. In croup and diphtheria the rapid inflammation and associated toxic condition cause rapid and intense contraction and congestion of the supra-hyoid muscles, which will in most cases rapidly, though perhaps temporarily, yield to the pressure and manipulation.

Stretching

Stretching the muscle is a method that is employed by many osteopaths for the purpose of producing relaxation. It is doubtful whether such a method usually results satisfactorily. Theoretically

there is much to be said against the process. The process of stretching a muscle is one method of increasing the irritability of the muscle. Lombard is authority for the statement that "the irritability of muscles is likewise increased by moderate stretching and destroyed if it be excessive." Hence it would certainly seem illogical to attempt relaxation by increasing its irritability. Neither would it be the part of wisdom to destroy the irritability by excessive stretching. A muscle in the condition of contracture will be stimulated to still greater contraction by throwing it out of tension and yet there seems to be no question that in a certain percentage of cases the process does result favorably and the explanation is sought. The stretching of a muscle, thus increasing its tension, corresponds in a way to the exaggeration in case of an osseous lesion, and in that case there is secured the benefit of recoil. In addition reference is again made to the fact that muscle contracture is not identical with muscle contraction, and in the process of stretching, the congested material and waste products are more or less forcibly expressed from the contractured tissue, though no relaxing effect might be gotten on a simple contraction. In all cases when attempting relaxation by this method a simple rule of guidance is usually sufficient. Separate the origin and insertion of the muscle. In case the scaleni muscles are found contractured on the left side, bending the head to the right with the shoulder a fixed point separates the attachments and hence produces stretching. Hyper-extension of the thigh stretches the anterior femoral muscles, while extreme flexion of the thigh on the abdomen puts tension on the posterior muscles of the limb. Pulling the middle portion of a muscle in a direction transverse to the course of its fibers produces tension of the muscle although the absolute distance between the two attachments of the muscle actually may have been lessened, as in the case of an upward and outward manipulation of the spinal muscles in the region of the lower thoracic.

Approximation

Another method less subject to abuse is that of approximation of the origin and insertion. In this method the attached structures are forced toward each other. That this method is efficacious as a temporary expedient few will deny. Just as the tension can be removed from a rope attached to posts by bending the posts toward each other, so to an appreciable extent can the tension be taken

from a muscle by forcing nearer together the points of attachment. Further, this method seems to be a most natural one, and one resorted to involuntarily in many cases. Note the characteristic position assumed by a victim of peritonitis in which the superficial abdominal tissues are intensely tightened. The patient lies supine with the limbs flexed at the hip and the head and shoulders raised, the total effect on the musculature of the abdomen being an approximation of the origin and insertion of most of the muscles concerned. A further instance indicating the value of this method is the flexing of the head dorsally upon the neck in a case of suboccipital contraction; or the flexion of the arm at the elbow for the purpose of relaxing the biceps preliminary to the reduction of a dislocated shoulder.

It is seldom that any one of these several methods is used alone and it is in comparatively few cases that it is possible or advisable to avoid using two or more of them. For instance in the case of a contractured scalenus muscle a common method is first to bend the head away from the side of the contracture, which stretches the muscle, then to rotate it back, which approximates the origin and insertion, and at the same time to exert pressure directly upon the muscle fibres. In this case three of the methods are employed and it is altogether likely that during the course of the movement the deeper structures are opened up, impingement taken off the nerve which supplied the muscle, and hence the irritation removed and a fourth method employed. The point was emphasized in the case of the method by pressure that the application should be gradual. It is equally true of the other methods, and not only with reference to the application but the removal of contact should be gradual for if the removal be sudden there results an abrupt change. Abrupt change, whether from a lower to a higher or from a higher to a lower level, constitutes a stimulus, and a stimulus means further contraction. Another caution of some considerable value has reference to the relative temperature of the hand of the physician. If the manipulation is made upon the tissues it is necessary for best results that the temperature of the part and of the physician's hand should be approximately the same. Especially is it advisable if the physician has cold hands to warm them before beginning the treatment, otherwise the shock produced by the difference in temperature will be a distinct added stimulus for further contraction, a result not at all to be desired.

CHAPTER XXXI

TREATMENT OF OTHER LESIONS

Thus far there has been discussed certain general principles underlying the treatment of bony subluxations and muscular contractures or rigors. It becomes necessary to suggest a few points of practical value in regard to the other forms of lesion which the osteopath must often meet. In all of those cases of perverted size relations of parts, the physician has to deal with some nutritive disorder responsible for the perverted growth lesion, and hence in such cases it is necessary to seek the further lesion or other cause of the nutritive condition and give attention to its reduction. In a second class of cases the lesion of perverted growth has resulted from direct violence producing a bruise or other enlargement in which the same considerations of treatment apply. The reduction of these is largely accomplished through dependence on normalizing all of the associated structures and relying on normal processes of absorption to remove the surplus material.

Tumors

In some cases it is necessary to resort to surgical removal. A tumor of the abdomen is a perverted structure which by pressure upon the hypogastric plexus or other vital structure may produce disorder of various forms. The treatment of such a lesion depends upon the condition of the patient. Correction of every cause of disturbed circulation and innervation, and perhaps the surgical removal of the tumor itself, are indicated, according to the nature of the neoplasm, the effects produced by its pressure upon neighboring organs, and the prospects of its becoming diminished or its assuming rapid and malignant development. Overgrown muscles and exostoses have been known to cause disorder by direct obstruction and hence are considered as lesions; the removal of such will depend upon the same factors which are suggested in reference to the tumor.

Connective Tissue Lesions

The overcoming of connective tissue lesions is a matter of no

little difficulty. A typical lesion of this type is found in the rigid spine more or less normal to the aged individual and often met with in younger people who have suffered from some violence. This rigid spine condition, where it is not of a temporary nature such as would be produced by simple muscle contraction, is caused by a thickening, contracting and lessening of the fibrous and other ligamentous structures associated with the vertebræ; or by a deposit in the articular structures of various substances, as in the case of chronic gout and articular rheumatism; or finally, a condition of bony ankylosis. In all of these cases it is a serious question whether a complete cure can be effected or very great benefit given, owing to the difficulty of removing such lesion by any known methods. In most cases it will largely be a "breaking up process" designed to open up the deep structures, thereby overcoming tension on nerve and blood-vessel and permitting a free opportunity for absorptive processes to be maintained.

A further type of connective tissue lesion is found in the case of cirrhosis of the liver where the connective tissue framework has been formed in excess and has subsequently contracted, thereby reducing quite appreciably the total volume of that organ and very considerably obstructing the portal circulation and the metabolic activities of the liver. In the case of sclerosis of the spinal cord we have also a connective tissue lesion of a serious nature. In this case the neuroglia of the cord is thickened and contracted producing or following a degeneration of the nerve elements. In both cirrhosis and sclerosis the outlook for removal is unfavorable. For we know that while a regeneration of nerves does take place in peripheral structures, there are as yet no authentic cases of regeneration of the nerve fibres in the spinal cord. All that can be reasonably expected in such conditions is the limiting of the further progress of the disease and a partial absorption of the morbid deposit by establishing and maintaining a normal spinal circulation.

CHAPTER XXXII

Time Required

A few questions of general interest invariably arise in the mind of the student with regard to the difficulty experienced in overcoming the lesion, the time required to effect a cure, and the frequency and length of treatment, and it seems advisable to note a few of the facts which enable us to explain the varying results obtained, and suggest the factors necessary to consider in judging cases, although it must be noted that in many instances no rules are applicable, and the judgment of the physician in connection with the peculiarities of the immediate case will be the only court of appeal.

The first to be noted is an explanation of the fact that lesions are not immediately removed. Osteopathy has made its reputation before the world perhaps more because of a few occasional startling instances where a single treatment has overcome a case of long standing than by the vastly greater number who have been cured only after long and toilsome effort on the part of both physician and patient. The strength of the system is derived from the latter case but it is most noticeably brought to the attention of the world by the former. Why is it that all cases are not of the quick cure class? If the treatment consists in rearranging the subluxated parts why not do so immediately as does the engineer with his engine? There are several facts which serve to explain this situation. In the first place the man-machine does not quickly change its parts under normal conditions. While there is continuous change it is a process requiring time. It is no less true in abnormal states. The vitalizing force carries forward its work of repair certainly but slowly. In this there is a marked distinction from the man-made machine. Again, it is necessary to remember the conditions presenting themselves in case of a lesion. When first produced the tendency is to draw back into line or otherwise overcome the abnormal part by the inherent power of adjustment. In many cases nature is successful in this effort. In occasional cases she is unable to accomplish the result and in such cases is the field of operation for the

physician. But note the second effort on the part of nature. Failing in applying adjustment by drawing back to normal alignment the perverted structure she applies it in the way of adjusting the surrounding structure in position and form to the new abnormal one. This becomes especially noticeable in case of hip dislocation, where it is known that the superior hip muscles have permanently shortened while the inferior ones have correspondingly lengthened. A general rearrangement of parts also takes place in case of a vertebral or a rib lesion, so that in numerous cases the new condition becomes finally a normal one in the sense at least of producing no marked abnormal functioning; not normal, however, in the sense of the new arrangement being as substantial as the original. In a certain percentage of such cases there is still a partial failure to adjust and a real and chronic lesion prevails. It is necessary for the physician to either overcome this partial adjustment or to give enough of aid by manipulation to permit a full adjustment to the new condition. In either case it is obvious that some considerable time is necessary. Of course the above considerations have special reference to chronic lesions. In acute cases much less time and fewer treatments will be required.

In many cases the lesion is not entirely removed, that is, in the sense of securing a complete return to normal of the perverted part. This is less often true when we consider the other side of the lesion idea, the perverted function. For while in many cases the perversion of structure may not be entirely overcome, in most of these the perverted function has disappeared. Note the fact that as a general rule the function becomes normal before the structural perversion is entirely overcome. This fact depends on the power of adaptability possessed by the organism. It is able to produce normal function with tools that are not as yet ideal. From this fact may be seen one explanation of the lesion's incomplete reduction. The patient, as soon as he feels normal and sees no further symptoms of any disorder, assumes that his cure is complete; and for the time and perhaps permanently that is true. Hence he refuses longer to pursue the treatment. In all such cases emphasis should be laid on the fact that the incomplete structural reductions remain a weakened condition and hence are a continuous menace to the health of the individual either in causing a return of the original disorder or of another that is possible from the same lesion. Further, owing

to the partial adjustment that has taken place in the chronic case the strength of the new articulation or adhesions may be such as to defy the most persistent treatment. It seems reasonable, however, that in the great majority of cases the original normal condition of structure as well as function may be restored provided opportunity in the way of time is secured.

Frequency of Treatment

With regard to the frequency of treatment, only general rules may be given. At the risk of becoming tiresome, the statement must be emphasized that it is not the physician but nature that heals. If it were the former, one might be justified in frequent attempts to adjust a part .Since it is the latter, time must be permitted in order that the gradual process of repair should take place. It must be remembered that a condition which is such as to preclude immediate adjustment must be one in which a process of adaptation must take place before the part can be restored to its original position. It must be a growing back in real truth and growth requires both time and quiet. If a beginning can be made in reduction at the first treatment one should be satisfied; then allowing sufficient time to elapse for adjustment to the new conditions that have been produced, the process of repair and restoration can be carried forward with sufficient rapidity. In general a frequency sufficient to compel a continuous soreness throughout the entire interval is too great. In chronic diseases the average case prospers most satisfactorily with treatment applied two or three times per week. But each case must be a study in this sense as in others. In some cases a greater, and in many cases a less frequency of treatment is found most satisfactory. For instance, Dr. Still has always insisted—and younger practitioners are learning slowly that he is right—that the ordinary case of asthma should not be treated oftener than once per week or ten days. On the other hand acute conditions require more frequent attention. In such the changes are much more rapid both with respect to repair and to the pathological states that are produced. Further, owing to the latter fact there are continually arising secondary lesions and other causes of disorder which must have attention. An acute case usually needs treatment one or more times per day during the more critical periods.

Length of Treatment

The considerations in the above paragraph hold in part in regard to the length of the treatment. The young osteopath invariably gives more time to an individual treatment than will an older practitioner. It is characteristic of Dr. Still himself that he "treats a case and goes," and his success is no less remarkable than the brevity of his treatment. There is such a thing as drawing upon the vitality of the patient by a too lengthy treatment. It is not likely a long treatment will be given except by him who gives a general rather than a specific one. For it takes but a few moments to produce sufficient irritation of a local part to cause serious and successful protest on the part of the patient. Where the body is treated as the masseur treats, much time is required, but osteopaths are not masseurs. Cases are met with occasionally where, owing on the one hand to lack of skill on the part of the practitioner and on the other to an extreme tissue tenderness of the patient, some preliminary treatment may be necessary before specific work can be given. In such cases time may be used to good advantage in somewhat prolonging the treatment. In nervous individuals any indication of hurry on the part of the practitioner will react unfavorably on the patient.

With reference to the rapidity of movement a caution is necessary. In dealing with all cases, whether primarily a lesion of bone or other tissue, quick movements are rarely advantageous. A quick movement usually acts as a stimulus to an already hyper-sensitive tissue. Hence the tissue is made to "set" against the effort to move it. Muscles and other tissues directly worked upon in treatment are structures which in disease conditions change their shape and condition only gradually. The tissue can be led but only with difficulty, and with much possible harm will it be driven to its normal relationships.

There is a possibility of harm in the treatment by manipulation. The statement is repeatedly made that "if osteopathy does you no good it will do you no harm." The statement is interesting in that it is more or less untrue. Osteopathic manipulation properly applied is not likely to result in danger but in the hands of an individual unacquainted with the laws of leverage and the arrangements of the levers which he uses in most movements, there is much pos-

sibility of harm. While it is not true that the force sufficient to reduce a lesion is sufficient to produce one, yet there is enough of truth in it to be worthy of notice. The harm may result because of the intensity of the application. The intensity may be either in the abruptness or in the absolute amount of force used. There are certain leverages in the body by which a sufficient force may be applied to rupture the strongest ligament, while a force not so great but suddenly applied may easily produce serious injury.

The harm may result because the treatment is too prolonged. In such a case the tissue either becomes exhausted or what is more common, overirritated, with a resulting congested or inflamed local area. In the same way irritation may follow too frequent treatment, in which time for repair is not given. Under such circumstances there is little possibility of producing satisfactory results and much chance of causing further disorder.

The above considerations on the possibility of harm from treatment wrongly applied are not given simply because of theoretical reasons. Sufficient evidence is brought forward to show that disorder has resulted. With ordinary care and average judgment the treatment is entirely harmless, but where those qualities are lacking it may not be so. In any case it would not be a difficult matter to show that while there may be some danger associated with the administration of osteopathic treatment it is infinitely more safe than that of drugging.

With reference to the method of the movement that may be employed it is necessary to emphasize that probably no two practitioners who have been long in the field execute a particular treatment in exactly the same way. There are a large number of methods in the employment of the same principles of adjustment, each of which may, under certain circumstances, present its own advantages. Individuals differ in the ease with which a movement can be executed. Hence it is illogical for a teacher to insist that a method must be employed because it is the correct one. It is not necessarily so. The patients themselves differ quite markedly in reference to the readiness with which they yield to particular treatment and it is found by experience that what is perfectly appropriate in one individual may not be satisfactory in another although the lesion may to all appearances be the same in each case. True,

in all movements account must be taken of the leverage employed; the physician must know the situation of articulation, the attachments of muscles and the like. But he can only know these as they exist in the average case. Every new case will present new conditions and will require at least slight differences in the application of treatment. Hence in a later section discussion is given to a few common movements that are in general use merely to emphasize and illustrate the principles that underly every adjustment that is effective. The mere imitation of any physician's peculiar methods is always unsatisfactory. Understand the forces it is necessary to use, determine in each case through what parts these forces may be applied, then adapt the method to the circumstances of the case. By following such a plan the student becomes a man of emergencies and learns to use his mental powers on each individual case instead of yielding to the pernicious habit of passing each of his cases through the routine of an unvarying set of manipulations.

CHAPTER XXXIII

STIMULATION AND INHIBITION

Like all systems of healing, osteopathy has been presented by various classes of its advocates in various disguises, and as a result has been at times entirely misrepresented. While it is a matter of course that its professed enemies should attempt to mislead, it is quite unfortunate that there are a few of its professed followers who, in attempting to uphold the system, have unwittingly placed it on a par with other systems by imitating or directly asserting that osteopathy is a method of treatment by mechanical stimulation and inhibition of nerve impulses. It cannot be too strongly emphasized that such a position places the osteopath on the same plane with all other schools of healing, the underlying principle being the same in kind and differing only in method. He who assumes that the above definition of osteopathy is a new conception in therapeutics and one which embraces the essentials of the osteopathic philosophy has not only failed entirely to grasp that philosophy but has shown an ignorance of medical history quite unjustified. For such history is replete with evidences that mechanical stimulation and inhibition applied by definite manipulations have long been known and used—centuries before osteopathy had been brought into the world. But with the rise and development of osteopathy and the newly awakened interest in drugless systems which in part resulted from that development, these various methods have been subjected to investigation as never before through the study of literature bearing on the subject and the application of mechanical measures to disease conditions. Hence, by a hasty though not unnatural inference, was deduced the conclusion that the new method was but a special modification and extension of the old. It is sufficient in this connection to affirm that stimulation and inhibition as definite osteopathic procedures are measures that have been superadded to the original and primary conception, and in so far as they may be used at all are insignificant in importance.

The last statement suggests that there is a possible use for these methods and under the circumstances of an undeveloped and incom-

plete science and a lack of knowledge and skill on the part of the practitioner the statement may be true. Under certain circumstances it may be impossible or impracticable for the osteopath to apply specific osteopathic treatment and in such cases it will be expedient for him to place himself upon the same plane with the practitioner of other schools and use the least objectionable of the methods of the latter. In order to understand the nature and possible value of these methods it seems advisable to speak of them somewhat in detail.

By stimulation of a nerve or an organ is meant the process of acceleration of the function of that nerve or organ. By inhibition is meant the process of retarding the function of a nerve or organ. Both of these processes are attributes of normal living tissue, more especially of the nervous system. The voluntary contraction of a muscle is a normal or physiological stimulation of that muscle; the effect of food on the gastric mucosa is a normal stimulation of the function of secretion; the excess of carbon dioxid in the blood is a physiological stimulus to the respiratory center. On the other hand a voluntary impulse sent to the spinal cord center which cuts off the reflex movement that would otherwise occur is an instance of a physiological inhibition; the vagus nerve carries inhibitory fibres to the heart muscle which retards the activity of that tissue; impulses passing by way of the sympathetic filaments to the muscles within the wall of the intestinal tract causing a slower peristalsis are spoken of as viscero-inhibitory. These are all examples of the physiological or natural inhibition. By mechanical stimulation or inhibition reference is made to the artificial process which causes or is supposed to cause by pressure a similar effect. Note that the process is artificial. A mechanical stimulus applied by the hand of the practitioner is emphatically not a natural but an artificial stimulus.

It is said that the liver is stimulated by producing pressure directly on it or by otherwise compressing it; the pneumogastric nerve is stimulated by pressure along its course for the purpose of increasing its function in lessening the cardiac activity; in prolapsus of the rectum the atonic walls are stimulated by local treatment. On the other hand the physician inhibits the phrenic nerve for controlling hiccoughs; pressure exerted along the splanchnic region

inhibits the cramping in various forms of colic; pressure exerted in the lumbar and sacral regions and along the course of the sciatic nerve will often temporarily relieve sciatica.

These treatments are referred to as stimulating or inhibitory and the assumption made that it is in truth the increasing or the lessening of nerve action by a direct process. Is such a control possible? The author has heard the human body compared to the piano upon which the practitioner plays, bringing out the harmony of action as the musician produces the harmony of tone. He has heard it compared to an electric system upon which the intelligent osteopath may send messages and shunt the currents and connect the circuits. The statement has been made that the vital fluids and forces of the body are absolutely under the control of the skillful operator. The essential thing lacking in these comparisons and statements is the element of truth. The human body is not at all like a piano, neither does the osteopath play upon it as would the musician. It is not an electric system that can be operated upon to any degree as the electrician manipulates his batteries or his keys. The forces and fluids of the body are fortunately beyond the control of the physician, skillful though he be.

A few facts with reference to anatomy and physiology may not be out of place as indicating the insurmountable difficulties in the way of securing the absolute control suggested above. It seems advisable to again repeat that function is self regulative and structure nearly so, and it is the business of the osteopath to deal with structure, not function, and to deal with structure only as that structure is in an abnormal condition. But can the nerve be stimulated and satisfactory results follow?

CHAPTER XXXIV

DIFFICULTIES OF DIRECT CONTROL

In the first place we are just beginning to learn the functions of nerves. There are a few hundred million nerve fibres in the human body the function of most of which are known only in part. It was thought that the function of the pneumogastric in reference to the heart was known to be inhibitory, yet it carries also accelerator fibres. It was assumed that the efferent tract that passes from cortex to muscle carries only an impulse resulting in contraction, but evidence is accumulating to show that it carries also an inhibitory impulse. It was believed that the sacral nerves carried motor impulses to one layer of muscle tissue in the rectal wall and inhibitory impulses to the other layer, but Langley, Anderson, and others have exploded the "crossed innervation" theory. In the light of these facts as to the function of the nerves it is presumption to assume that any such marked control over functions as suggested above can be gained.

Greater difficulty in securing a very complete control of nerve action by direct means is obvious when the fact is noted that the same nerve may have different functions. Bear in mind that the nerve is not a separate structure but is made up of an indefinite number of nerve fibres each one of which may be associated with a distinct and different action. The vagus, for instance, has efferent fibres controlling motion and vaso-motion, secretion, inhibition and trophicity (?), and efferent fibres associated with sensation, vomiting, vaso-dilatation, and perhaps a host of others. All these are bound up in the same sheath. Imagine the nicety of control possible to the practitioner under such an anatomical arrangement! Any efferent nerve may, on being stimulated by mechanical means, modify any of the numerous functions of a spinal segment. Who will direct the excess of impulse into the right channel? Nearly every nerve that carries vaso-constrictor fibres carries also those of a dilator function. The presumption in claiming an arbitrary choice of effects in vaso-motor stimulation is evident.

A third fact is noted in that the nerve it is desired to affect

may not be in its usual situation. The inhibition of the phrenic nerve is often impossible because of the simple fact that it is not in the location where pressure is applied. Any one who has had occasion to do much work in the dissecting room will be impressed with the numerous exceptions to the rules of location of structures. Attention was recently called to a case showing the spinal accessory nerve passing across the end of the transverse process of the atlas.

In close connection with the above the fact should be noted that the vast majority of nerves are beyond the possibility of direct manipulation, a very wise provision of nature. Stimulating the splanchnic nerves is spoken of as though these structures were laid bare to the touch. Perhaps in reality there is produced acceleration of function in many cases. But it certainly must be done through a very indirect route, and that through the complex arrangement of a reflex mechanism.

The latter suggests a fifth very real difficulty in the way. Most stimulating and inhibiting treatments are explained on such a reflex basis, an explanation which in some cases seems rather strained. Note that in the stimulation of the nerves associated with the spinal region, for the purpose of affecting the splanchnic nerves must pass by the afferent spinal fibres—fibres which have a choice of many neurons to which their charge may be delivered. It is but a remote possibility rather than a likely probability that sufficient of the excess of stimuli shall reach those cell bodies whose axons pass to form the splanchnic pathways. The argument that use is made of that explanation for the visceral disorders resulting from spinal muscle contracture does not particularly enhance the proposition that the osteopath can cause the effect that is produced by the lesion. Note that the lesion is either a much more intense stimulus or is prolonged over a greater period of time. Should the osteopath keep up continuous stimulation of such nerves for some hours sufficient excess of stimuli might be discharged into the splanchnic channels to amount to a real stimulation. But no such length of stimulation period is indulged in by the average practitioner. Further, to argue that the excess will all be poured into the channels needing it because nature "tends to the normal," hardly meets the demands. It is true that nature tends to the normal, but it is further true that so far as function is concerned the tendency is in part toward that

condition which is normal to the existing structure, i. e., to that condition which is permitted by the existing structure. So long as structural conditions are at fault the functions are likely to remain so. When those conditions are overcome no additional stimulus is necessary.

A further difficulty presents itself in cases where the stimulus may be applied either directly or reflexly. The intensity of the stimulus cannot be gauged in proportion to the need in the particular case. In laboratory work in physiology the mechanical stimulus is seldom made use of for this simple reason. It is effective but cannot be regulated in intensity, hence the use of the electric stimulus which is susceptible of nicety of control. How much pressure shall be employed in order that the exact amount of increase of function shall be produced? There can be no answer to the question. Why not employ the electric stimulus, then, instead of the mechanical in osteopathic practice? For the very good reason that electrotherapists themselves have tried it and found it wanting. And not because of any necessarily harmful effect on the tissues produced by the current as such but because the positive results were unsatisfactory. That it will be found equally true of the mechanical stimulation we are thoroughly convinced.

We have finally to mention a fact that is of first importance and that is that in all cases where function is artificially changed by increase or decrease there will be a recoil in the opposite direction. This is notably true with respect to experimental stimulation in the laboratory. Goltz's experiment on the inhibitory action of the cardiac nerves of the frog is a case in point. The following is the description of the experiment: "In a medium sized frog the pericardium was exposed by carefully cutting a small window in the chest wall. The pulsations of the heart could be seen through the thin pericardial membrane. Goltz now began to beat upon the abdomen about 140 times a minute with the handle of a scalpel. The heart gradually slowed and at length stood still in diastole. Goltz now ceased the rain of little blows. The heart remained quiet for a time and then began to beat again, at first slowly, and then more rapidly. Some time after the experiment the heart beat about five strokes in a minute faster than before the

experiment was begun. The effect cannot be obtained after section of the vagi.''[1] Note that the final effect was not inhibition, but stimulation.

Some experimentation has been and is being done at the present time by osteopathic investigators to show that a direct effect can be produced in case of man and lower animals (rabbit) by stimulation and inhibition in connection with the cardiac nerves and the splanchnics, a proposition to which assent has already been given. While these explanations seem to substantiate the proposition that such a direct action is possible it remains to be shown that the effect is at all permanent or advisable, and more especially to prove that a recoil is not inevitable or probable. Further observation of such experimentation is awaited with interest. What is true in those cases in which accurate experimentation is possible is reasonably true of all others. Any swing of the pendulum past the position which is normal under the existing circumstances will be compensated for by a recoil of opposite sign. Note the fact that the organism brooks no interference with its function and will return to its normal activity when it has by sudden force been disturbed in that activity.

Thus far reference has been made to some of the difficulties which beset him who would attempt by nerve stimulation or inhibition to secure a definite control over the functions of the organism. Admitting that notwithstanding these difficulties there is still possible a limited and temporary control, it is necessary to consider certain objections to the use of these measures, and also the conditions where such treatment might be necessary or helpful.

[1]American Text-Book of Physiology.

CHAPTER XXXV

USE AND ABUSE OF DIRECT CONTROL

By stimulating or inhibiting a nerve or other structure the physician interferes with normal function. It has before been suggested that function is normal to structure. Making simply a general statement, every function, be it usual or unusual, is what it should be under the circumstances of existing structure. An increased peripheral resistance to the blood flow causes an overactive heart. This latter condition is normal under the circumstances. It must increase its activity in order to keep up normal circulation. The attempt to limit the heart's action by inhibiting it is a distinct hindrance and an illogical treatment. Suppose that the peripheral resistance was maintained so long as to exhaust the heart's action. The lessened force resulting is still normal to the structural conditions. The stomach in discharging its contents through the esophagus is performing a normal function and so long as it can by that method rid itself of irritant material vomiting should be unhindered.

Note further that a stimulus applied to a failing function is in many cases crowding an already overworked organ. Notice one of the foregoing illustrations. When the heart by reason of an imperfect blood supply, through lesion or otherwise, is weakened, the work it is performing represents its capacity at the time. If a stimulus is applied to the accelerator nerves to hasten its action, only an earlier exhaustion can be the result. Attention is called to the fact that the accelerators like other motor nerves cause an increased muscle activity, they increase its tone, its excitability, and its conductivity, which in turn is associated with a more rapid katabolism. Hence in causing this increase only a more rapid exhaustion of the reserve force stored in the heart muscle or in other centers of supply is produced. The same principle is applied to each organ in the body. Its function is not decreased because of an inherent laziness, but because of the adverse effect produced upon it by incorrect structural conditions, or by toxic states or by lack of nutritive material.

The reaction may be as great as the original action. Leaving the structural conditions as they are, a temporarily accelerated peristalsis of the intestine is followed by a period of still further diminished bowel activity. Just as in the use of a cathartic a constantly increasing dose is necessary to produce an action till finally it becomes ineffective, so a mechanical stimulus will be followed by a lessening response. A stimulation of the vaso-constrictors is followed by a great vascular dilatation. An inhibitory treatment for pain is occasionally followed by a return of the sensory disorder in greater intensity.

In many cases the palliative treatment serves only to conceal a serious condition. Osteopaths condemn the old school practice of giving morphine for lessening pain and yet in numerous instances make use of exactly the same reasoning and practice with barely a thought of the consequences. The concealment of a pain condition from the patient by any treatment without the removal of its cause is a crime against the patient, if the pain is necessary for diagnosis of the case. The plea that the patient insists on it or that it gives nature a chance for repair is seldom a sufficient justification. The lessening of a rapid heart beat often gives a sense of security entirely unwarranted by the real state of that organ. The "tonic" treatment gives a temporary sense of exhilaration similar in kind if not in degree to that following moderate doses of morphine or alcohol. This form of deception is little more justifiable than any other and as often results disastrously.

These statements do not apply to the use of palliative measures after the corrective treatment has been decided upon, or in those cases in which fatal outcome is to be anticipated. Relief of pain under such circumstances is the duty of any physician.

A final objection that is exemplified occasionally is the fact that a treatment habit may just as really be formed as a drug habit. In both cases the organism eventually tends to rely on the artificial stimulus instead of the natural one for its proper functioning. That individual who requires frequent treatment to be kept in normal "tone" is as much a treatment habitue as he who requires the daily application of the needle, a morphine fiend. And yet many osteopaths pander to the temptation by advertising the value and pleasure to be derived from a "tonic" treatment.

But it would be incorrect to leave the impression that such attempt at direct control is never justified. Experience seems to suggest that while there are numerous possibilities of ineffectiveness or of real harm in such purely palliative treatment there are occasions where such procedures may be a choice of evils. For it cannot be denied that in many cases stimulating and inhibitory treatments have been and will continue to be given with marked benefit. Note that it is insisted that the good results gotten are necessarily dependent on nerve stimulation or inhibition. To this phase of the question reference will be made later. At present mention will be made of those cases in which such treatment is theoretically or practically demanded.

Indications for Attempts at Direct Control

In those cases where a lesion is not apparent, and no other known cause is apparent a treatment in the region of innervation is often seemingly helpful. In occasional cases the ordinary practitioner will not be able to detect splanchnic or other lesion affecting the stomach and yet stomach trouble exists. Treatment applied in the lesion region for such disorders is effective. A lax condition of the general circulatory mechanism is sometimes seen where no definite lesion can be assigned for the disorder. A general spinal "toning up" is resorted to with at least temporary benefit. An overactive peristalsis is often checked by strong pressure in the lumbar or lower thoracic region. Pain is lessened by treatment over the structures associated with the sensory nerve involved.

It would seem to be helpful to apply a stimulus after removal of lesion or other cause. The analogy is drawn between the cases of a stalled horse whose progress is hindered by a stone in front of the wheels of a vehicle, and an organ working against a hindering lesion. In each case the propelling force has become discouraged. After removal of the stone it may be helpful to "touch up" the horse with a whip, and likewise to "touch up" the organ through its nerve mechanism. The liver is often directly manipulated by pressure after the spinal lesion is removed. The sluggish kidney responds to treatment after the lumbar lesion is removed. A uterine headache will be sooner overcome if a cervical treatment is given following the adjustment of the uterus than would otherwise be the case.

In rare cases removal of the cause may be impossible or impracticable. In such cases it is a question whether to leave all to nature or to attempt to bring out any latent power of nature that the condition itself fails to arouse. In ankylosis of the spine the lesion is a bony union and as such is practically impossible of removal. The functions interfered with thereby may be aided by occasional treatment of the spinal regions and of the involved organs directly. Intense nervous or mental excitement interfering with direct treatment to the primary lesion may be decreased by pressure applied in the suboccipital region; it may be necessary to lessen pain, where present in such intensity as to prevent use of the various methods of diagnosis or treatment.

In some cases direct stimulation may force an obstruction and hence be a factor in the removal of a lesion as well as in overcoming an effect. Increasing the heart's force may overcome a congested venous or capillary condition. Direct work over the liver may increase bile secretion and thereby assist in removing obstruction to the gall-duct. Direct treatment to muscle tissues may assist in adjusting the structures to which those tissues are attached.

In occasional instances it may be necessary to resort to heroic measures in order to tide over the crisis. In case of a sudden heart failure direct pressure over the solar plexus or manipulation in the accelerator region may assist in preventing collapse; in case of hemorrhage an extreme stimulus applied to the part may temporarily check the flow; spasmodic laryngitis or croup may be prevented from terminating fatally through strangulation, by treatment of the laryngeal and other structures.

In some cases it may be advisable for the osteopath to place himself on the same plane with the old school physician and treat the symptoms as they arise, for it is to be noted that a symptom may in some cases seem to be a distinct hindrance to normal processes of repair. With reference to pain, while it is of value to the organism in numerous ways its great intensity in some cases renders it a distinct disadvantage and inhibition may become helpful by lessening the nerve disturbance, thereby giving the organism a better opportunity for repair. An excessively high temperature becomes a menace to the life of the individual and direct treatment for purposes of lowering that temperature may be called for. The rapid waste of the fluids of the body in certain diarrhœic conditions

contributes to an undue weakness and may be prevented by inhibitory treatment. In case of excessive vomiting when all is ejected the nervous disorder permitting it may be adjusted by inhibitory treatment.

It will be noticed that in most of the foregoing cases the treatment partakes largely of the nature of a choice of evils and suggests what it is necessary to emphasize continually, that these measures are only to be employed where, in the judgment of the physician, the primary and logical treatment, removal of the cause, is not immediately possible or practicable, and in those cases in which symptoms persist after corrective treatment.

But if further analysis is made of the above cases it will be found that the words stimulation and inhibition are deceptive in many cases. In the ordinary acceptation of those terms it would be understood that the function of the part disordered was increased or decreased directly or through its connecting nerve. But this reasoning is erroneous. In the first set of conditions referred to stimulation was employed where no apparent lesion was present. Emphatically that does not mean that no lesion was present. In the application of a stimulating treatment to the region of innervation, it is reasonable that instead of pure stimulation of those nerves by a quick pressure alternating with relaxation there results in reality a removal of actual impingement upon nerve or other structures which rendered their activity subnormal. Note a typical case. In occasional instances of constipation no very distinct spinal lesion is apparent; all experience indicates that a stimulating treatment through the lower thoracic and lumbar regions is more effective than is a quiet pressure treatment; if the results were dependent upon direct efforts produced on the splanchnic nerves the latter form of treatment should be the more effective, for the physiological result of stimulation of the splanchnic nerves is a lessened peristalsis. In such a case as this there is undoubtedly produced an effect upon the involved nerves, but it is done indirectly through the removal of pressure conditions in the spinal region which were producing the existing inhibitory effect. What is true of the stimulation in this case is probably true in the vast majority of cases. If it is the direct stimulant effect on the nerve, why will not titillation of the skin in the process of tickling, or the application of an electric stimulus be productive of equally good or better results?

In the second class of conditions the analogy between the horse and the organ is far-fetched. While it is true that the horse may become discouraged there is nothing to indicate a possibility of a similar condition in case of an organ; on removal of the lesion the disease condition itself is the only "touching up" process necessary to arouse the entire responsive powers of the organism. When the removal of the lesion is impossible the so-called stimulation may, perhaps, be a real, though incomplete removal of a part of the lesion condition. Any breaking up treatment of the spine in the rigid condition of that structure opens up the tissues and undoubtedly frees the nerve and vascular mechanism of the spine sufficiently to account for the benefit that results from the treatment.

With reference to the inhibition of pain which is the typical example of the value of inhibition as a therapeutic measure, a few considerations may not be out of place. This proposition is fundamental: the success in overcoming any pain condition is in direct proportion to the amount of structural adjustment effected. Given a pain condition with little removable structural change present, the possibility of diminishing that pain will be a minimum; with the more removable structural abnormality associated with the pain will go the maximum possibility of pain removal. For instance, there are numerous cases of pain resulting from visceral disorders. In these cases there will be muscle contractures in the spinal region either primary or secondary. In either case the pain will be overcome in proportion to the extent to which the muscular contracture or other lesion is diminished. Reference has been made to the fact that in experimental physiology it is most difficult to apply pressure gradually enough to prevent stimulation, not to speak of the possibility of lessening the nerve action concerned.

Pressure upon tissues diminishes the amount of liquid within their meshes; this applies to lymph and blood, as well as to edematous fluids. When the pressure is removed, the fresh arterial blood flows more freely, and the alkalinity of the tissues is restored, and edematous fluids are less freely formed.

Physiological experimentation shows that the stretching process at first renders the nerve protoplasm more irritable; if long continued its irritability becomes lessened or totally destroyed, in which case there must be produced a disturbance in the arrange-

ment of the protoplasmic molecules such as to interfere with their normal relationships. Such an explanation may account for the good effects that often follow the stretching of the sciatic nerve in so called sciatic rheumatism. The other explanation is the more probable, that, by the hyper-extension of the limb, tension of the associated structures is removed with a resulting lessening impingement upon the nerve and its branches.

In summing up the discussion emphasis is to be laid upon the fact that the removal of lesion or other cause of disorder constitutes the logical treatment for that disorder. When a structure or organ needs stimulating or inhibiting, it can be done in but one proper way and that an indirect way, by removal of the cause that makes it necessary to stimulate or inhibit. Hence the two following similar propositions may be formulated:

1. The necessity for stimulation presupposes an existing inhibition; the removal of the cause of that existing inhibition constitutes the legitimate method of stimulation.

2. The necessity for inhibition presupposes an existing stimulation; the removal of the cause of that existing stimulation constitutes the legitimate method of inhibition.

These propositions are fundamental and comprehend the essence of the osteopathic view of the treatment of disordered conditions, and are applicable to the entire field of disease.

CHAPTER XXXVI

TREATMENT OF DISEASE CAUSED BY ABUSE

In discussing the causes of disease attention was called to the fact that abuse of an organ or its function ultimately produces a diseased condition of that organ. What constitutes the legitimate treatment for such cases? It is obvious that what is undoubtedly called for is the negative treatment of simply stopping the abuse. If stomach disorder be caused by continuous overloading, lessen the load. If writer's cramp result from excessive exercise of the limited set of muscles, stop writing. If the environment conditions are such as to subject the individual to abuse of the respiratory tract, move out and away from such environment. This proposition seems valid: in case of disease due only to abuse and not associated with structural disorder, no positive manipulative treatment is indicated. Through ages of false training the belief has become established that for every apparent disorder something should be done in the way of definite artificial treatment. Reliance has heretofore been placed on the drug. With the one who has learned of the efficacy of osteopathic measures he assumes a treatment is necessary under the similar circumstances. In many cases he is right. In numerous cases he is wrong. In those cases where temporary disorder results from manifest abuse, treatment is unnecessary and perhaps harmful. In this regard advocates of any form of psychic therapeutics are essentially correct. Let alone, nature will be the all-sufficient factor in cure. But experience and reason both indicate that there are limits to the recuperative power of nature, and osteopaths emphasize that in many cases that limit is represented by a definite obstruction in the machinery through which nature manifests her curative power. In such case artificial aid is indicated. Note this fact: most cases primarily due to abuse are not unassociated with structural disturbance.

In many cases a predisposing lesion is present which represents a factor involving definite difficulty in nature's reparative process. In other cases secondary lesions will arise which add to the disorder and constitute new causal factors. In both of these cases definite manipulative treatment is called for and without question is advan-

tageous. Hence it is found that cases in which treatment is not necessary or helpful are comparatively rare, and the osteopath should never fail to carefully examine a condition before he pronounces it a case requiring no treatment except the negative one of abstinence.

Will a patient recover under osteopathic manipulation when he refuses or is unable to abstain from abuse? Numerous cases of such are found. Occupations requiring life in adverse circumstances of environment must be continued by many in order that life itself may be supported. The miner still must live in the mine, the writer still must use his exhausted fingers, the unfortunate must still use ill-nourishing food. Can such recover? In countless cases, yes. In any case, only with greater difficulty. As illustration may be cited any number of cases of eye trouble that have been successfully treated in osteopathic colleges while the patient was taking the school course, and was compelled thereby to abuse his eyes. So long, however, as abuse is the sole factor, which is only an occasional condition, little can be done if the abuse is continued.

On the other hand, will a patient recover, if predisposing or secondary lesions be present, no manipulative treatment be given and the patient simply abstains from abuse? Undoubtedly in a large number of cases. For it has already been shown that while function is much more markedly self-regulative than structure, yet the natural processes of the body alone are successful, in many cases, in overcoming definite structural changes. This is the more noticeably the case with reference to the lesions which have arisen as secondary processes during the course of abuse than in those cases in which a predisposing lesion was present from the beginning. In the latter case it may be that the tendency to the disorder is not overcome, and hence the condition regained be that of the organism previous to the abuse; the lesion with its associated predisposition still exists. Occasionally, however, after injury or abuse of an organ, the reaction may involve related structures, the lesion predisposing to disease be corrected by natural forces alone, and complete recovery occur.

In all cases in which lesion conditions of any kind are present, good practice and common sense indicate that both removal of the lesion and of the abuse must go hand in hand if the most satisfactory results are to be obtained.

CHAPTER XXXVII

OSTEOPATHY AND CELL LIFE

The inherent power of the organism to adjust itself must, in the last analysis, rest in the power of individual cells to act, not only as individuals, but also as units of the organism as a whole.

"In multicellular organisms, every cell must maintain its structural integrity if it is to maintain its normal function. Things which affect the gross structure of the body are efficient causes of mal-function only as they affect the structure or the environment of the cells of the tissues. This is the reason why gross deformities so often cause only slight mal-function,—the cells remain fairly normal in structure and environment. For the most part, however, gross changes do affect cell structure and environment; it is only occasionally that individual cells remain unaffected by deformities."[1]

"Cells vary greatly in size, shape and micro-chemical reactions; these structural variations are associated with corresponding functional activities. The cells of any one tissue present certain similarities of structure, so that the tissue from which any group of cells is taken may be recognized by the characteristics of the cells and their relationships. The substance of which cells are composed is so nearly alike that it is all spoken of by one term, being called "protoplasm." Living protoplasm can neither be analyzed nor synthesized. The very act of analysis destroys the molecule of dead protoplasm, to say nothing of that which is living. During life there is constant flux; nourishment is constantly being taken in, digested, built into living tissue, or built into deutoplasmic material of extremely variable types; the molecules employed for storing energy or food are constantly being built, utilized and destroyed; katabolites are constantly being produced and eliminated, so that at no two consecutive instants of time is any mass of protoplasm identical.

"Now life is something of which we know practically nothing, except as it manifests itself. It is impossible to define life in any exact manner. This is also true of every fundamental thing; no

[1]Burns: Basic Principles.

one can exactly define life, heat, force, matter, the elements, our own minds, yet we all know that these things act, and how to use them in many ways. Herbert Spencer's definition of life,—"the continual adjustment of internal conditions to external relations" is an expression of this fact. Dr. A. T. Still's definition presents a similar view, "Life is an individualized Principle of Nature."[1]

"In living substance, the matter exists in the form of a large number of very complex labile compounds,—complexes of molecules. Verworn objects to the term "living molecule' as the word molecule signifies a definite chemical compound of some stability, while instability and change are the essential characteristics of living substance. He therefore suggests the term "biogen" to designate those exceedingly complex compounds that are at the focus of life and by means of which vital phenomena are manifested."[2]

Each of these molecules may be considered as a machine for the performance of certain duties in the life history of the cell. If these machines are inefficient, the duties involving upon them must be improperly performed.

"By chemistry the truths of physiology are firmly established in the mind of the student of nature, that in man a chemistry of wonderful powers does all the work of animal forms, and that in the laboratory of nature's chemistry is the ruling power. Thus in chemistry we become acquainted with the law of cause and change in union, which is a standard law sought by the student of osteopathy."[3]

"As the result of the peculiarities of cell structure and the relations of its biogens, each cell and probably each part of the cell has the power to select just the quality and quantity of each material from the blood and lymph that it needs for its nourishment and function.

This selective function, as it is called, is often affected in various ways and results in many disorders, When for any reason, the normal protoplasmic activity is disturbed, naturally the function of the cell is disturbed and the cell may be invaded by substances that it does not need, in fact that it can not make use of. As a result

[1]Spring, C. F., The Cell.
[2]Hulett, C. M. T.: Biological Basis of Osteopathy.
[3]A. T. Still: Research and Practice.

inert and sometimes harmful substances may be deposited within or around the cells. This is the case in the formation of gouty tophi, uratic deposits, and the various degenerations and infiltrations. On the other hand, the cell may fail to take up that which it ought and the cell be poorly nourished. These trophic disturbances are very numerous and are manifest by a vast number of symptoms.

"The rebuilding process of the tissue cells is not very clearly known; for just why the cell selects certain elements and rejects the remainder is not known. Of the organic foods, the proteids seem to be the only ones that enter into the building up of the cells. The carbohydrates and fats are the energy producers. The proteids, in the absence of the fats and carbohydrates, furnish some energy, so that it is possible to maintain life for an indefinite period on proteids alone; though not at the best advantage.

"The selective function is found not only in the cell as a whole, but in the protoplasmic molecule as well."[1]

[1]Spring, loc. cit.

CHAPTER XXXVIII

CELLS OF MULTICELLULAR ORGANISMS

"It is very necessary for the higher forms of animals to be composed of cells instead of a single mass of protoplasm for three reasons. First, to give form to the body there must be a hardened tissue (formed by a certain kind of cells) to act as support in order that the form may be maintained. The nature of the cell in this tissue must be such that it will stand considerable strain and pressure to form a steadfast framework. This frame is covered and rounded out with muscle and other tissue, and different kinds of cell formation. Second, that the function of the body may be increased to the highest state of efficiency. Since each part is formed by a certain kind of cell, organized to perform a certain function, it can do this better than an undifferentiated mass which must do all kinds of work and therefore can do none well.

"Third, for the sake of nutrition. Small cells, bathed in nutritious lymph, are easily and quickly fed, while their wastes are easily and quickly removed. A large protoplasmic mass with a single nucleus fails in these respects. The surface of any mass varies according to the square of the diameter; the mass varies as the cube. Hence, the larger the cell, the more disproportionate is the relation between nutrition—providing surface and nutrition—demanding mass.

"Metabolism may be defined as 'any change produced in the body upon matter by living tissue.' This process is confined to the organism, with living tissue as the actor and the matter acted upon may be either living or lifeless material. Naturally then this subject comprises many different activities in the body.

"For the sake of convenience metabolism is divided into two sub-heads, anabolism and katabolism. Anabolism comprises those processes which are constructive in nature, or building up; while katabolism is the destructive process, or breaking down. These are very closely related and occur simultaneously. Every movement, every chemical change, in fact every manifestation of life, is evidence of metabolic processes at work."

"The energetics of a cell present themselves in various forms, which may be grouped as resisting or potential energy and as moving or kinetic energy. Among the former we have chemical, osmotic, cohesion and gravitation forces, and among the latter mechanical power, heat, light and electricity. But naturally this classification

[1]Spring, loc. cit.

is not fixed, because some of these energies may present themselves in either form. The chemical energy, for example, remains potential only so long as the atoms retain their position toward one another and become kinetic as soon as they arrange themselves in accordance with specific affinities. Thus the animal receives potential chemical energy in the shape of complex organic substances and oxygen. The regrouping of the former under the influence of oxygen eventually gives rise to carbon dioxid, water and simpler nitrogenous bodies as well as to a large amount of actual (kinetic) energy. Metabolism, therefore, is intended to keep the organism in energy-equilibrium. The chemical intake and outgo are balanced in such a way that the cells can continue to furnish the energy required of them. The metabolic equilibrium and the dynamical equilibrium must in the long run pursue a parallel course."[1]

"The activities of living organisms consist of responses to stimuli. A stimulus may be anything which produces a change in spontaneous vital phenomena. The character and degree of response depends upon the chemical and physical forces involved in the constitution of the organism and its relations to its environment.

"Typical living substance existing in an ideal environment, in which the conditions of vital phenomena—the character of the surrounding medium, the food supply, moisture, heat and light—were exactly suited to its needs would by reason of what Hering terms "the internal self-regulation of metabolism" present a condition of chemico-physical metabolic equilibrium. The spontaneous vital phenomena would present a uniform succession of events. But any change in the environment would be followed by a change in the metabolism of the living substance, an adaptive adjustment of internal conditions to external conditions. Life being manifested only by a constant change of matter, the first response would be to the presence of waste products of metabolism, which as soon as separated from the living substance are foreign matter, inimical to the welfare of the organism. It, therefore, responds to their presence by excretory action. We may imagine that the matter next to that eliminated is now moved up to take its place and that a succession of such responses occurs throughout the series involved in the integrity of the living substance. At the beginning of the series there will be a demand for new material, which will be shown by the response of the organism to the presence of food. Thus the maintenance of the equilibrium of the matter and energy of living substance itself may be conceived as a series of responses to stimuli. But these we cannot segregate and study separately, as they are inseparably bound up with life, and remain or disappear with it.

[1]Burton-Orpitz: Physiology.

CHAPTER XXXIX

CELL RESPONSE TO STIMULATION

"Observation of changes in the activities of the organism in response to changes in the environing conditions, has already yielded to investigation much of value, and is pregnant with promise of much more. Davenport recognizes eight agents that act as stimuli on living organisms, viz: Chemical substances, water, density of the environing medium, molar agents, gravity, electricity, light, heat. The effect of these, separate or combined, in modifying the course of spontaneous vital phenomena, constitute the field of cellular physiology and pathology. It will be seen that this includes all physiological processes, when we recall that the individual cell of the body may be conceived as existing in an environment consisting of neighboring cells (including the nerve filament that may supply it), water, chemical substances (in the blood and lymph), nutrient substances, waste products, heat, and, in some cases, light; and the resultant of the variously combined effect of these upon the differentiated and specialized forms of cell substance is seen in the different physiological functions. The action of these cells may be influenced by variations of the heat of the body, as in fevers and inflammation; by the presence of nutrient substances as in digestion and assimilation; by the presence of waste matters, as in excretion; by various manifold stimuli conveyed to them by the nerves; and in a thousand complex forms many of which we cannot yet analyze.

"The nature of the response to stimuli is a property of the organism, not of the stimulus. The mechanism of the metabolic cycle precludes any effect of stimuli except in two directions, viz., excitation or depression. The successive changes have a specific order of sequence. Qualitative change in the cycle would mean death. Only quantitative change is possible. The multitude of cycles which we may imagine in progress at the same time in living substance, may be changed in their relations to each other. Some may be excited, some depressed and some stopped altogether. The infinite variety thus made possible justifies the supposition that

the protoplasm in any individual may never twice be the same in structure. Protoplasm, therefore, is not to be regarded as a chemical, but a morphological concept.

"An important factor in the functioning of cells in a multicellular organism, is that the component cells, no matter how widely differentiated, morphologically and physiologically, have their limits of capacity for response approximately in the same plane; otherwise there would be no such thing as co-ordination of function. This plane varies as between different individuals and in the same individual at different times. These considerations explain the varying effect of drugs upon different persons, or upon the same person at different times, and it also explains why drug medication can never be reduced to an exact science.

"We have seen that protoplasm is a 'highly irritable automatically adjustable substance,' and that the cells in a human body respond to the stimuli of varying external conditions in an adaptive way, not only with reference to the cell itself, but also to that of the whole body, and we are now prepared to inquire into the abnormal conditions constituting disease.

"Disease may consist in a disturbance of the metabolic cycle, as in the various degenerations, or it may be due to failure of the normal response.

The statement may be ventured that all disease may be ascribed to a failure of protoplasm to respond; first to the stimulus of its own internal vital phenomena, resulting in an interruption of the metabolic cycle—disturbed nutrition; and second, to the stimulus of abnormality in its environment—pathological products and bacteria—resulting in neoplasms, autointoxications and infections; and such failure to respond when continued can eventuate only in death.

"Extraneous stimulation is not necessary; but if the capacity for response still remains, we will have this condition: Pathologic substances, by their presence in the organism act as stimuli at two points; first, at the point of initiation of the abnormal process there may be such reaction to their presence as tends to restore normal metabolic conditions by overcoming the cause of stoppage or irritation, as in 'self-limited' diesases; second, the mechanism of elimination reacts to their presence by increased excretory processes to get rid of the products of stoppage or irritation. If the conditions are right these reactions take place if need be to the full limit

of the reacting power of the cells exhibiting them. In other words, the cure of disease requires the presence of no other stimulus than that of its own products. The application of any extraneous stimulus in the form of drugs, electricity, heat, water, what not—with the idea of revitalizing or reforming in any direct way, the metabolic cycle, is not only futile, but wholly superfluous, and 'adding insult to injury.' Nature neither needs nor can use any assistance in her work. What nature does need and what we may do is to maintain suitable external conditions. Therapeutics then has only to do with the elements of the environment in which nature works. In this sense antidotes to poisons are necessary; heat may be applied to chilled tissues, and water may serve as a food element, or for cleansing, externally and internally.

"If living substance responds to abnormalities in such a way as to bring about their correction, disease ought always to be cured spontaneously; indeed, it ought to be wholly prevented. That it does so respond is seen in the constant elimination of waste products of metabolism; and that there is sometimes a failure in spontaneous removal of abnormalities may be due to one or both of two conditions; to exhaustion of the power of response, or to interference with its manifestation. The first is illustrated systemically in the effects of starvation, overwork, excessive use of drugs, alcohol, etc. The second is the basis of osteopathic practice and requires some examination of the mechanics of vital processes.

"The relations of the metabolic cycle to the conditions of its expression are very aptly illustrated by Davenport, who compares the protoplasmic mass to a factory, with many boilers and engines, much shafting and belting, and countless machines doing the most varied work. The amount of energy developed in the boilers and the efficiency of the engines and machines varies with certain conditions, such as the amount of heat applied to the former, and the friction and waste in the latter. The limiting mechanical conditions are reached when the boiler is rent by the steam pressure, a breakdown is caused by friction or a part rusts through and crumbles away. The limiting dynamical conditions are reached when the heat no longer suffices to force steam in the boiler, or the power is insufficient to run the machine. In either case at the structural or the dynamical limit, work ceases. In protoplasm the structural limiting conditions are of two main sorts—mechanical,

in which the gross structure becomes broken down, as in drying or freezing; and chemical, in which the composition becomes changed as in the effect of poisons, high temperature, strong electric current, etc. The dynamical limiting conditions are the absence of oxygen or other food stuffs, the absence of water necessary to the solution and circulation of the food, and too low a temperature. "Thus the conditions essential to metabolism are the absence of causes mechanically rupturing the machine, the absence of agents of such intense activity as to change profoundly its molecular constitution, and the presence of those agents—food, heat, light and water—which supply or distribute the energy of metabolism. Given protoplasm under these conditions, and normal metabolism must occur; without them there is no metabolism.' Surely if such a figure correctly illustrates the conditions in a bit of apparently homogeneous jelly-like protoplasm, it is not inappropriate when applied to so complex a structure as the human body!

"Physical conditions are our only field of intervention. We have seen that equilibrium in the ingestion and output of substances—normal continuity of the metabolic cycle—by the cell is the essential internal condition of the integrity of the vital processes. This equilibrium is always maintained by reaction of the cell to changes in its environment to the full limit of its reacting power. In order that this power of reaction shall be normally expressed, it is necessary that the physical conditions of the cell substance shall be normal. We are barred from any direct participation in the vital processes so far considered. We cannot interpose upon the organism an exercise or condition not required by the laws of its economy. Our field of intervention must lie in the physical relations existing in the organism. Let us examine these conditions.

"The size of the cell is one of these conditions. By the operation of certain mathematical laws of growth concerning the relation of surface to mass, the single cell is kept very small, so that a close relation between the cell and the surrounding medium is possible. in plants where air is the medium, exposure is secured by extensive external branching. In animals where the medium is liquid, exposure is secured by extensive circulatory channels. Its bearing on the mechanics of nutrition is the only reason for referring to this.

"Another condition is the movement of protoplasm within the cell, a characteristic clearly shown in low forms of life, in which

constant currents in the cell substance are found. In the hair-like pseudopodia, which many of these organisms throw out, outflowing and return currents are to be seen. Even when these pseudopodia themselves are so slender as to be almost to the limit of visibility under the microscope, these currents have still been demonstrated. Similar movements in cell substance either en masse or of a fluid portion through the interstices of a recticulum occur in the human body in the cells of glands, epithelium, muscles, nerves, in the blood, and possibly others. These movements aside from their specific relation to the special function of the cell, are necessary to the ingestion of nutrient material, the exchange of material between different parts of the cell, and the egestion of waste products.

"Perhaps the most important physical property of the cell is that of contractility, a property that is characteristic of protoplasm, and although the complex requirements of such an organism as the human body have resulted in highly specialized cells for certain properties, yet these cells have lost none of the fundamental properties of protoplasm. For instance, muscle cells, differentiated for contraction, still exhibit irritability and secretion. Gland cells differentiated for secretion are still irritable and contractile. Nerve cells differentiated for irritability still secrete as required by their own metabolism, and retain contractility as shown in the contraction and ameboid movements of ganglion cells in the lengthening and shortening of their dendrites. . . . The conclusion is forced upon us that the conditions of mechanical stress in the cell structure and in the tissues, varying in degree and in time, the result of chemical, thermal or other stimuli, acting either directly or as mediated by disturbed nerve mechanisms, are important factors in the problem of the causation of disease.

"Somewhat different in character and scope, but yet intimately related to cell-activities, is the effect of nerve stimuli. In all the higher vertebrates and especially in man the predominating influence of the nerve is almost absolute. So dependent are the other tissue cells upon this form of stimulus that in its absence spontaneous action is lost or sinks to the lowest point. A normal skeletal muscle never contracts except it is stimulated, and if its nerve supply is wholly lost, its metabolism sinks to so low an ebb that it degenerates by atrophy. Gland cells are another example of this dependence, and even in the nervous system itself there is often an interdepend-

ence between ganglion cells. . . . The direct effect of nerve stimuli upon processes of metabolism; upon the processes of secretion and excretion, as in gland cells, and in the regulation of the conditions of stress—tone—in all contractile tissue, both intra- and extra-cellular, show the importance of the part they play in coordinating the innumerable activities in so complex an organism as the human body. The contractility of dendrites is an important point, considered in connection with the statement that the relation between the dendrites of one nerve and the axone of another is that of contiguity but not continuity, as it explains how nerve currents may be switched."[1]

The function of the nervous system is to unify diverse structures, —in normal and abnormal conditions; in time, and in inheritance. During normal activity of normal brains, this important part of the nervous system unifies individuals and races in their civilized activities.

The osteopathic view of the cell, whether as a unit or as one of the millions making up the human body, is largely covered by the following statements:—

Normal structure is essential to normal function.

Normal function is essential if normal structure is to be maintained.

Normal environment is essential to normal function and structure, though some degree of adaptation is possible for a time, even under abnormal conditions.

In the human body, with its diversified functions, we may add also,—

The blood preserves and defends the cells of the body.

The nervous system unifies the body in its activities.

Disease symptoms are due either to failure of the organism to meet adverse circumstances efficiently, or to structural abnormalities.

Rational methods of treatment are based upon an attempt to provide normal nutrition, innervation and drainage to all tissues of the body, and these depend chiefly upon the maintenance of normal structural relations.

[1]Hulett, C. M. T., loc. cit.

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